

# Aviation Week

*and Space Technology*

A McGraw-Hill Publication

March 5, 1962

**Lunar-Landing  
Altimetry  
System Devised**

**Aerojet Large  
Solid Rocket Firing**





**Honeywell Visicorder Oscillograph checks resolution of an event marker**

Electro Development Corporation, Seattle, Wash., uses a Model 1108 Honeywell Visicorder Oscillograph to prove the linearity and resolution of signal conditioner-event markers which they supply to the Boeing Company.

A missile telemetering system samples each channel only once every 30 milliseconds, but missile engineers want to know when some events occur to an accuracy of better than one microsecond.

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Where 1/8 inch at left shows roughness, seal after prolonged immersion in JP-4 fuel. Smooth parts at right were not immersed.

### PROPERTIES CHART

<b>Physical Properties</b>			
Resilience, 50% def.	90-95		
Tensile Strength, psi	800-3000		
Disruptive, percent	150-175		
Seal Life	—10		
<b>Fuel Resistance (JP-4)</b>			
	Dehydrate	Facile Swell	Facile Change
After 30 days immersion	—10	—31	+18
<b>Weather Resistance</b>			
After 21 months (1966 avg. temp.) at Florida Test Station			no visible effects

For information about Silastic LS and a list of jet suppliers, write Department 130, Dow Corning Corporation, Midland, Mich.



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## AEROSPACE CALENDAR

- Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.
- Mar. 16—Annual Report II Coddard Memorial Symposium, Engines and Air Tech. Section in Seattle, American Astronautical Society, Washington, D. C.
- Mar. 20-21—University of Denver Second Materials Symposium in Thorndike-Turkess, Denver, Colo.
- Mar. 20-26—International Convention in status of Radio Engineers, Calverton and United States, New York.
- Mar. 20-25—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Kentucky, Lexington, N. Y. Sponser: American Institute of Electrical Engineers, Institute of the Aerospace Sciences, Institute of Radio Engineers University of Rochester.
- Mar. 26-30—Fourth Annual Electronic Space Symposium, Allied Electronics Corp., Cambridge, Mass.
- Apr. 1-4—Mid-Year Conference, Aeronautics Quarterly Council, Sheraton Hotel, Washington, D. C.
- Apr. 5-14—Aircraft Vehicle Structures and Materials Conference, American Rocket Society, Ronaldson Inn, Fairfax, Va.
- Apr. 15—National Astronautical Meeting (including production issues), Society of Astronautical Engineers, Hotel Commodore, New York, N. Y.
- Apr. 9-13—Third Annual Scientific Meeting, American Nuclear Association, Sheraton Hotel, Las Vegas, Nev.

(Continued on page 7)

## AVIATION WEEK and Space Technology

March 5, 1962  
Vol. 26, No. 90

Aviation Week and Space Technology is a leading authority on the latest developments in the aerospace industry. This month's issue is devoted to the theme of "The Future of Space." It contains a special section on the "New Frontiers of Space," which includes articles on the latest developments in space exploration, the future of space travel, and the potential of space technology. The issue also features a special section on "The Future of the Earth," which includes articles on the latest developments in earth science, the future of the earth, and the potential of earth technology. The issue is a must-read for anyone interested in the latest developments in the aerospace industry.

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**GENERAL ELECTRIC**

## AEROSPACE CALENDAR

(Continued from page 5)

- Apr. 18-22—Second Symposium on The Plasma Sheath—its Effect Upon Re-entry Communications and Detection, New England Naval Ship, Boston. Sponsors: AF Cambridge Research Laboratories
- Apr. 21-25—Southwestern Conference and Business Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.
- Apr. 22-23—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Sheraton Chicago Norel Chicago, Ill.
- Apr. 22-23—English Annual Heat Transfer Conference, Oklahoma State University, Stillwater, Okla.
- Apr. 23—Government Contractors Symposium, National Assn. of Professional Contractors, Administration, Ambassador Hotel, Los Angeles, Calif.
- Apr. 24-25—Second Conference on Electronic Equipment and Performance of High Temperature, Institute of California Metals, Los Angeles, Calif. Sponsors: Western States Section, Combustion Institute
- Apr. 24-25—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England
- Apr. 25-26—Aerospace Systems Technology Progress, Institute of the Aerospace Sciences, Salt Lake City, Utah
- Apr. 24-26—Polytechnic Institute of Brookline Symposium on the Mathematical Theory of Aerospaced Fluid Engineering Center, New York, N. Y.
- Apr. 25-26—Western Space Age Industries and Engineering Exposition, Cox Palace, San Francisco, Calif.
- Apr. 26-27—Quintuple Regional Meeting, Assn. of Local Transport Admin. Offices, Los Angeles, Calif.
- Apr. 28-May 1—Annual Meeting, National Aeronautics Science Assn. Sheraton Hotel, Washington, D. C.
- Apr. 28-May 1—Meeting on Mars and Space Flight, Institute of the Aerospace Sciences, Hotel Chateau, New York, N. Y.
- May 1-3—Spring Joint Computer Conference, Personnel Institute, Washington
- May 2-4—1966 Annual National Forum American Helicopter Society, Sheraton Park Hotel, Washington, D. C.
- May 2-4—International Space Research and Technology Exhibition, London, England. Sponsors: British Interplanetary Society
- May 2-4—Test Instrumentation Symposium, Human Factors in Electronics, IRE, La Jolla Hotel, Long Beach, Calif.
- May 2-5—Materials & Processing in Space Environment, Symposium, Sheraton at Aerospace Medical and Protein Symposium, Hotel Statler, St. Louis, Mo.
- May 2-5—Annual Conference, Society of Photographic Scientists and Engineers, Sheraton Hotel, Boston, Mass. Cosponsors: AF Cambridge Research Laboratories
- May 2-5-1967 Tool Exposition & Engineering Conference, Public Auditorium, Cleveland, Ohio
- May 3-6—27th Annual Electronics Components Conference, Marriott Twin Bridges Motor Hotel, Washington, D. C.
- May 14-26—National Aerospace Electronics Conference, Institute of Radio Engineers, Sheraton Hotel, Dayton, Ohio

(Continued on page 9)

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**Spacecraft to Be Simplified as Result of MA-6 Flight, 16**  
 ► Mercury capsules for 15 orbit missions will reflect greater reliance on instrument for control of flight.

## Eastern Submits New Low Fare Formula 30

► Lower New York-Miami price, elimination of some meals costs of economy, better distribution

## Lunar Altitude Measuring System Described 26

► Technique, called "Work Twin," would enable lunar vehicle to measure its height above surface out to 200 m, or more.

<b>SPACE TECHNOLOGY</b>		<b>AIR TRAFFIC</b>	
NASA's Vision on Space Resources	36	Design Program Library	38
Commercial Space Bus Plans	36	Political Factors Affecting Space	37
Space Fuel Cell Contract Won	37	U.S. Probes European Joints	37
Larger Solid Rocket Speeding Up	29	Galileo Project—December 1985	37
Jetway Liquid Rocketway Feasible	37	Airline Observer	38
U.S. Rocket Launches	38	Shortlines	38
European Jet Engines Sell Rocket	38		
Western Designs on Rocket Design	38		
Space Shuttle Launches	39		
Flight Chemistry May Cut Costs	39		
		<b>MANAGEMENT</b>	
		Union Trouble Before Congress	39
		ESL to Modernize Management	40
		ESL to Modernize Airports	40
		UAC Considering Mosaic Contract	39
		Industry Observer	41
		Worker Shortage	41
		Washington Roundup	41
		Newsp. Report	37
<b>HELIX ENGINEERING</b>		<b>BUSINESS NEWS</b>	
MAHRIE Mosaic Delivered	25	Reliance on Oil Shakes in San Angelo	57
		South American Airlines Air Power	57
		Private Lines	57
<b>AERONAUTICAL ENGINEERING</b>		<b>FINANCIAL</b>	
8122 DCB Transformer Shown	41	ESL Contracts	99
Boeing A 439 Flight Plans	41	Airframe Colander	99
ESL to Modernize Airports	41		
Production Briefing	41		
<b>AVIATION</b>			
United Allotting Systems Declined	24		
Market Traffic Control System	24		
Antennas to Watch World Sales	42		
ESL to Modernize Airports	42		
ESL to Modernize Airports	42		
Other Contracts	42		

## REFERENCES

### Abstract

**COVER** Second firing of an Avroget-Guard 120 in dual-propellant rocket motor at Sacramento, Calif., June 27, and, top, second test, 800,000 ft. increments thrust and an average thrust of about 190,000 lb. (see photo p. 76). This was the first time in an Avroget motor of this size that thrust vector was controlled by fluid injection of reactive nitrogen tetroxide, although this type of control was used on Falcon boosters last test year as well as in smaller test motors. In the 100-ft-dia motor application, vector control by fluid injection sustained 600,000 to 1,000,000 lb. sustained thrust. Firing was with USAF's Edwards AFB Range Control group. Two more 100-ft-dia motors will be fired, the last probably in May.

**PROCEEDINGS**

04—Agricultural General; 15—E-100; 26—Energy Transfer; 37—Weather/Climate; 39—2025; 42—Civil-Infrastructure Engineering; 43—Civil-Other; 44—Civil-Transportation; 45—Civil-Other; 46—Energy Transfer; 47—Energy Transfer; 48—Energy Transfer; 49—Energy Transfer; 50—Energy Transfer; 51—Energy Transfer; 52—Energy Transfer; 53—Energy Transfer; 54—Energy Transfer; 55—Energy Transfer; 56—Energy Transfer; 57—Energy Transfer; 58—Energy Transfer; 59—Energy Transfer; 60—Energy Transfer; 61—Energy Transfer; 62—Energy Transfer; 63—Energy Transfer; 64—Energy Transfer; 65—Energy Transfer; 66—Energy Transfer; 67—Energy Transfer; 68—Energy Transfer; 69—Energy Transfer; 70—Energy Transfer; 71—Energy Transfer; 72—Energy Transfer; 73—Energy Transfer; 74—Energy Transfer; 75—Energy Transfer; 76—Energy Transfer; 77—Energy Transfer; 78—Energy Transfer; 79—Energy Transfer; 80—Energy Transfer; 81—Energy Transfer; 82—Energy Transfer; 83—Energy Transfer; 84—Energy Transfer; 85—Energy Transfer; 86—Energy Transfer; 87—Energy Transfer; 88—Energy Transfer; 89—Energy Transfer; 90—Energy Transfer; 91—Energy Transfer; 92—Energy Transfer; 93—Energy Transfer; 94—Energy Transfer; 95—Energy Transfer; 96—Energy Transfer; 97—Energy Transfer; 98—Energy Transfer; 99—Energy Transfer; 100—Energy Transfer.

87 161 copies of the virus sequenced.



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## EDITORIAL

### Man in Space

Let Col. John Glenn's orbital flight in the Mercury capsule offer some significant evidence on the role of man in space. The ballistic trajectory flights of Col. Alan Shepard and Capt. Gus Grissom were too short and simple to yield much data in this area. The orbital flights of Major Gagarin and Yuri Gagarin had been so steeped in Soviet secrecy and political hypocrisies that their international scientific contributions have been negligible.

Thus Col. Glenn's performance is really the first valid data generally available. The most important but is that the three orbit missions could not have been completed without his physical and mental capabilities inside the capsule. It would probably have been aborted at the end of the first orbit because of the difficulties with a one jet in the automatic stabilization and control system. Similar trouble with a well jet in that system forced the Mercury ground flight controllers to terminate the mission with three observations after two orbits. If this and other difficulties encountered by Col. Glenn during his three orbits had occurred in any of the unmanned orbiters space systems now being tested in polar orbits, they would have caused complete failure of the mission.

The ability of the properly trained human pilot to apply his judgment and skill to the functioning of the sensitive systems, coordinate their performance and shift to other methods of operation in the event of their malfunctions in the biggest reliability factor that can be designed into space systems. This is a well known fact to those with experience in experimental flight testing of manned aircraft. But it is an axiom that seems to elude many of the top scientists now participating on the space program.

### X-15 Parallel

Experience in the flight test program of the X-15, which bridges part of the gap between aircraft and spacecraft, indicates the value of the trained pilot in the vehicle. Of some 48 flights in the X-15 to date, some 24 would have resulted in serious failures without the ability of the pilot to cope with failures of the vehicle subsystems or equipment, and all would have resulted in the destruction of the vehicle and its experimental data. We predict that when the Mercury program is completed this same type of controlling pilot performance to mission completion will prevail.

Specifically applied to the Mercury orbital mission, Col. Glenn's performance indicates that several hundred pounds of equipment may safely be eliminated from the critical capsule weight to make way for the additional fuel support supplies required for the 15-orbit, 27-day mission that will crown the initial phase of NASA's manned space flight program. Without this trade-off of pilot's skill for additional useful weight, the 18 orbit mission would still be on for in the future when a booster larger than the Atlas would be available.

Col. Glenn's "rebellious measurements" also displayed a scope and analytical quality that would be impossible

to achieve with automatic equipment. The direction that he could provide for the first reconnaissance equipment available would enhance its performance in space far beyond the pre-determined, preset mission now performed in the unmanned Sasin and Atlas satellite systems.

Real time measurements provided by Col. Glenn certainly provided far more useful mission data than all the telemetry available on experimental flights of our satellites and manned vehicles.

There are, of course, many problems of man's survival and functioning in space that were not answered by Col. Glenn's flight nor are any of the currently planned Mercury flights likely to yield that necessary data. Although providing the longest period of weightlessness yet achieved by an American, the 4 hr 56 min flight was much too short to provide a true gauge of the effects of prolonged weightlessness on the human system. Col. Glenn's 100-162 mi. orbit was also too low to expose him to the radiation hazard that looms for deeper explorations of space. Providing the answers to these and many more questions regarding the human system in prolonged deep space environments is a continuing challenge that will face both astronauts and bio-astronauts for many years to come.

### Experts Refuted

We recall hearing some four years ago to a panel of distinguished scientists in Denver debate the feasibility of man in space. The unanimous opinion of these men at a symposium, sponsored jointly by the USAF Office of Scientific Research and the Institute of Aerospace Sciences, was that there was nothing man could do in space that could not be done better by automatic equipment, and that consequently, man's weight and environmental equipment would represent a squandered payload. Col. Glenn's performance during the MA-6 mission refuted their arguments in even sweep.

Thus it is appalling still to find at the top levels of presidential scientific advisors and at the top levels in the Pentagon the residue of the 1970's usage that man as man in space and ultimate survival of the fittest, that man can contribute little to the functioning of spacecraft. This means thinking a particularly dangerous when applied to the role of man in military space systems where the degree of the nation's capability may be the exact measure of the nation's ability to survive.

It was Capt. Cowdell's first orbit victory of the Douglas D-558 Mark 2 and the North American X-15, who several years ago started the case for the pilot about a flight vehicle of any type when he said:

"Where else would you get a one linear computer weighing only 150 lb. having a billion known decision elements that can be now produced by unaided labor?"

Where indeed, distinguished scientists who are still doubtful of man's role in space, where indeed?

—Robert Houss







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## Washington Roundup

### Chinese Nuclear Test

Wants the Chinese Communists to explode their first nuclear test device by midyear of this test center in Beijing promises to northeast China. It is expected to be a subcritical explosion in the 10 to 20 kiloton range. Soviet nuclear experts have noted the Chinese test site but the Chinese have declined offers of Soviet technical assistance on the grounds that it would violate the international practice that experts go from a nuclear technology developed without foreign help.

President Kennedy's long-overdue message outlining federal acquisition in the field of transportation may go to Capitol Hill this month. One reason for the delay from the White House has been the delay in road program from the railroad, airline and trucking lobbies. This also has been a reason why an over all transportation report, prepared by the Commerce Department and sent to the White House only last November, has not been made public.

### Soviet Space Tracking

Russia apparently is beginning to develop a space tracking and communication network beyond the geographical boundaries of the Soviet Union staff. The Soviet tech staff means that recently discovered four Russian V-2 class rockets in the Indian Ocean near at Beijing also may be planned sites for a tracking and communication station on the shores of Amoy and there in the South Sea. The mission would be to meet all its requirements for docking facilities that could handle heavy electronic equipment for the station. In another part of the world, the disposal of men and equipment to Soviet Antarctic surface stations at Mirny and Vostok in 1956 and 1958 already has been ordered. All but one of Russia's space stations has been launched into orbit having no activation in the center of 62 to 64 deg. Stations in Belarusia and the Antarctic will be able to monitor satellites in those orbits and in polar orbits, which are the best for reconnaissance vehicles.

Congressional testimony by John George W. Anderson, chief of naval operations, regarding Soviet missile submarine strength is based on intelligence that about 25 G and Zerkon submarines have been converted to fire missiles from the midline. These conversions powered only one missile and have an estimated time in status of only about 10 days.

### Missile Contract Probe

Investigation of government missile contracts by the Senate Permanent Subcommittee on Investigations is to begin within the next few weeks—probably May 19 or 20. Chairman John F. McClellan who is concerned about possible "proceeding of profits" will ask Defense Department officials and anonymous sources to submit contracts about several, especially in regard to the long negotiated. Staff members who are planning the hearings do not expect the subject of work stoppage at missile site since it was dealt with thoroughly last year. But a second stoppage in the number of stoppages probably will lead the Senator to run the case again.

Secretary of Labor Arthur Goldberg, who is working closely with both labor and management leaders in hopes of achieving harmony in the missile program, talked at length with Sen. McClellan last week.

These committee inquiries is scheduled to open hearings May 19 on communications satellite with Dr. Edward C. Wehr, executive secretary of the National Science Foundation and Space Council, in the Senate's office. But Wehr who has been ill with heart trouble (AW 1 Feb 17, p. 24) was hospitalized again last week after receiving himself in taking part in selecting ceremonies for Astronaut John Glenn (see p. 22), and now may be able to appear.

### NASA Information Plan

Swapping organizations of National Aeronautics and Space Administration's public information office is planned in an attempt to improve the space agency's public image. The pattern will follow that used in Air Force Headquarters with information office assigned as special assistants to the major technical offices. Of 17 staff professionals, all but half a dozen are to be given such assignments.

Some see this as a way to make information officers better acquainted with technical details of NASA's programs. But others fear dissemination and management of information by scientific and technical officials, who traditionally have been critical of less information than the agency's managers and information specialists, and who prefer to publish extensive reports of experiments in scientific journals before the information is made available to the general public.

Comprehensive statement on Air Force's space plans, made before the House Armed Services Committee recently by Lt. Gen. James H. Doolittle, USAF, deputy chief of staff for research and technology (see p. 21), was received before the Office of the Secretary of Defense, indicating that Air Force at last has gained top-level approval for some of its more advanced ideas on the importance of having a military capability in space.

—Washington Staff



MAKING IT: COL. JOHN H. GLENN (left) uses collapsible beds while in orbit. (Top left) he opens the view of his helmet. (Top right) reaches for food at pouch. (Lower left) examines tube from pouch and. (Lower right, etc.) Soyuzes launched at 10:59 a.m. EDT.

## Spacecraft to Be Simplified as Result

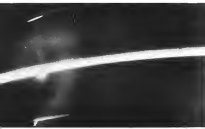
By Edward H. Koleson

Washington-Alton, automatic and backing systems considered necessary for manned space flight prior to Mercury. At that time, the complexity of the spacecraft was increased by the complexity of the man. Glenn, Jr., in the first U. S. manned orbital flight.

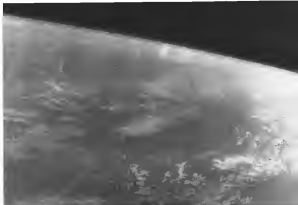
Although simple, results of Glenn's flight are still under analysis, one of the most striking aspects was the observation that a well trained pilot is able to outperform some of the automatic systems, and at the same time his judgment and observation is his scientific observation.

The means that a space pilot can be a versatile and dependable part of the manual control loop, the more he is as an aircraft.

Col. Glenn's performance, probably will be reflected in the detailed design of the 16-orbit Mercury capsule scheduled for a 27th manned flight only.



GLENN EFFECT is seen in this photo taken by Glenn's hand camera at sunrise. Flight line is horizon with sun at left. Smoke in upper left is believed to be "space boots." Smoke at lower left probably is reflection on capsule window.



EARTH CURVATURE is evident in photo taken by Glenn through capsule window. Area shown in photograph was not definitely identified but sun appears to be at right. Glenn took 178 photos with his hand camera, most of which have not yet been identified.

## of MA-6 Flight

will run. The extended mission which is the next major Project Mercury mission, will see increased reliance on the instrument as a pilot, rather than as an observer and monitor.

George M. Low, director of National Aeronautics and Space Administration Spacecraft and Flight Mission, said in specific outline have been picked for discussion from the three-act plan. Low says capsule to extend its capabilities to 15 orbits. He said the approach being used is to determine those systems whose man capabilities are needed, and then consider when to eliminate.

There is a need for a slightly larger supply of environmental oxygen, hydrogen peroxide reaction jet fuel, battery power and cooling water.

Less than 10 more pounds of weight is required to extend mission to 27 hr. and the amount of fuel used in the orbital flight is about 25% of that expended during the entire flight. Most mission feel it will be easier to fly, the capsule must be launched after it is in orbit into orbit and to station, it is



RETROCKET FROG: Glenn's hand took and he shot by men. Clock above one stage object ends 2:24 p.m. EST. Retrograde sequence was initiated at 2:28 p.m. EST.



STILL IN PRESSURE SUIT, Gus helps capsule after being hoisted aboard recovery ship.



BIOHERALD SENSORS are still attached to Gus as he dangles aboard the ship. Scurry on the left was reported blood pressure. Others detected heartbeat.

extra-long and during re-entry. Better power can be conserved by activating systems only when they are needed. This, in turn, will reduce the amount of coolant needed, because the waste heat source is from electrical units powered by batteries.

Among systems which may be eliminated is the 82 lb. powerpack, which has proved to be less effective for attitude reference than the window, both in the MA-6 orbital mission and the Mercury Redstone 4 infinite flight of Capt. Scott E. Crossen. Col. Alan D. Shepard's Mercury Redstone 3 capsule had a small port and he depended on his paragon for reference.

One of the three manual control systems was to be eliminated to conserve weight, and it is likely that some of the capsule's 11 "man-in-the-loop" seats will be eliminated for the same reason.

#### Control Systems

The Mercury capsule has an automatic stabilization and control system (ASCS) essentially an autopilot rate stabilization and control system (RSCS), a manual system using fuel-driven servomotors and connected to reaction control jet through a rate command electrical link. It is a rate control system using fuel from the automatic control tanks, which actuates reaction jet valves through the autopilot link, and the full manual proportional system, which takes pilot stick movements mechanically to reaction valves and uses fuel from the manual tanks.

Although Col. Glenn did not use RSCS, some pilots can prefer this to a trim system by wire. And even in this case, no choice has yet been made on which mode to eliminate.

Changes of air charge is to keep the 170-lb. Mercury capsule right in close as possible to the blast-orbit capsule, even if it runs a little behind the set of the Atlas 2 launch vehicle.

MA-6 capsule with the escape tower weighed 4,165 lb. at launch. At apogee in the orbital configuration it weighed 2,587 lb. Impact weight after dumping most fuel, the retrograde jet, perimeters and recovery aids, was 2,445 lb. Apogee and impact weights are based on preliminary computations.

#### Glenn's Wording

Although the MA-6 mission was considered completely successful both technically and from its unopposed prestige value, Col. Glenn injected a warning note during an interview before the House space committee late last week when he questioned the nation not to expect only successes.

"We must be prepared for failures and setbacks. We don't envision crash-landings, but in case of an emergency, the three we have had in fact, he said.



SENSE ATTACHMENT POINT under right arm is checked by Glenn. All sensors are reported to have a small country. At Grand Turk Island, right, Glenn has lunch with Astronaut Don Slayton, extreme right, during port flight excursion.



It was brought out that 100-175 centigrade, static friction below the flight and excessive action was not really needed in between Glenn and flight control.

The possibility of a "one best" shield—essentially assigned to a fault switch—was one which had not been foreseen. But analysis of the MA-6 mission was still another month later. Control point was that the orbit was so close to that predicted that the significant position probably will not change a great deal. Presently, Col. Glenn was already satisfied by his extended experiences.

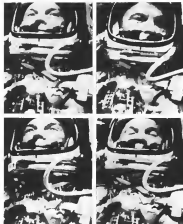
The main transmission were local and indicated position throughout the flight.

The astronaut showed no tendency toward surprise, nerves or discomfort, and he performed violent head movements to indicate any kind of action which had been reported in the flight of Redstone 3. Glenn's T-100 at Grand Turk Island did not occur until after the sixth hour of his flight, but all its distress at this time in that Col. Glenn would not have been affected during an extended space flight.

Col. Glenn and several times he has probably become an "addict to space" and he found the sensation pleasant.

Other highlights of the MA-6 flight which have been out since the initial launchings are:

- Automatic control problems has not yet been isolated, but some likely occurred when the guidance was under the 15 lb. reaction jet thrusts; outburst had become stopped. The hydrogas pressure, reaction jet system works this way, the fuel is fed to a control head through a small diameter tubing. It



RANDOM PHOTOGRAPHS of Glenn as what show head and eye movement while steering instruments and observing earth through the Mercury capsule window. All views of Glenn in orbit were taken by an automatic 16 mm motion picture camera with color film from which these black and white prints were made.



\$2.2 billion on infrastructure and support in the interim research and engineering, \$236 million on building and construction, \$1.3 billion on personnel, \$756 million.

Chief of Naval Operations Adm. George W. Anderson and other Navy leaders, as well as House and Senate members, are present here, and we expect the fact that they will make considerable progress in this area.

## NASA Attempts to Clarify Views On Rendezvous and Direct Ascent

By Herb Clark

Washington—Both rendezvous and direct flight to a target are considered to represent exploration of space and both are being pursued in part, or possibly all, despite an impression that the U.S. is developing rendezvous techniques at the expense of direct flight, a National Aeronautics and Space Administration official said today.

Milton W. Rosen, director of launch vehicles and propulsion in NASA's office of manned space flight program, said "the public should not expect one solution or the one or two." He said the present of both techniques "is not a dual approach but is like having both algebra and geometry at our disposal."

NASA officials have stated many times that rendezvous is the only approach to be the quickest way to achieve the national goal of landing men on the moon in this decade. They also have said that direct ascent would be used for later missions. Apparently

within the next few years "Adm. Anderson said at the Fiscal 1966 budget request we granted the Navy will have 2,250 operating aircraft, 962 days and 605,315 man."

In contrast to Gen. LeMay's testimony, both Senators at the Navy Committee and other House and Senate members are satisfied with the fact that both requests were handled by the Kennedy Administration.

They have left an impression that NASA favored rendezvous at the expense of direct flight. Rosen said that the development of rendezvous is not a dual approach but is like having both algebra and geometry at our disposal. He said the present of both techniques "is not a dual approach but is like having both algebra and geometry at our disposal."

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## NASA to Hire Management Firm

Washington—National Aeronautics and Space Administration will employ an outside management analysis firm to assess such major space agency decisions as whether to launch rendezvous or direct flight in the last year to reach the moon.

NASA Administrator James E. Webb told the House Science and Astronautics Committee last week that NASA will use professional firms to help in management decisions before the Defense Department takes up the issue. He said the agency would use the firm to study the issue and to make recommendations to the agency on the basis of the best available information.

The prospective contract and the size were reported to General Robert C. McDaniel, director of the Air Force Space Command, by a source in the Air Force Space Command. He said the contract would be for a period of 12 to 18 months and would be for a period of 12 to 18 months.

The House Space Committee is studying the issue. It is expected that the committee will report to the House on the issue in the next few weeks. The committee is expected to report to the House on the issue in the next few weeks.

of whether the use of it is to go to the moon, Rosen said. In some of the studies, Rosen said, the Navy will have 2,250 operating aircraft, 962 days and 605,315 man. In contrast to Gen. LeMay's testimony, both Senators at the Navy Committee and other House and Senate members are satisfied with the fact that both requests were handled by the Kennedy Administration.

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for direct flight in subsequent missions.

Therefore, Rosen is taking both as possible and not as "either/or" solutions. He said the Navy will have 2,250 operating aircraft, 962 days and 605,315 man. In contrast to Gen. LeMay's testimony, both Senators at the Navy Committee and other House and Senate members are satisfied with the fact that both requests were handled by the Kennedy Administration.

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## Kennedy's Comsat Plan Draws Strong Opposition in Congress

Washington—There may be a fight in Congress over ownership and operation of a world-wide communications system developed last week.

The President's proposal for a publicly owned, profit-making communications system, which would be operated by a private company, has drawn strong opposition from both sides of the aisle.

Senator Robert Kennedy (D-Calif.) said the plan would be a "disaster" and would be a "disaster" to the country. He said the plan would be a "disaster" to the country.

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ing (D-R.I.) commented that "you and me are not something you are with you and you have in all con-

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## Mobile Missile Delayed

Development of Mobile Midrange Ballistic Missile by the Navy has been delayed again by the Director of Defense Research and Engineering in order to evaluate critical production requirements for the NATO weapon system. The Navy will now be required to complete the development of the missile by the end of the year.

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The target of the southeast attack at the space conference was the Dr. Elmer W. Engstrom, president of Radio Corp. of America and its head of mobile missile systems. He said the plan would be a "disaster" to the country.

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## British Cancel Rotodyne After Spending \$30 Million on Program

London—Ministry of Aviation last week canceled the Westland Rotodyne VTOL transport after spending more than \$30 million on its development in the past six years.

Decision to end Rotodyne work followed a review of its military potential for Royal Air Force and civil use in British Aerospace's version, according to Minister of Aviation Peter Thompson last week.

Construction came when BEA, which is considering buying the Vertol 107, told Thompson that commercial prospects of the Rotodyne on its routes did not justify heavy costs of a production order. A single prototype, powered by Napier Gnome engines, has made 475 test flights. A Rotodyne® version for BEA would have been powered by Pratt & Whitney Turbogears (AW Sep 15, p. 40).

Thompson said there would be no serious financial loss to Westland Aircraft, the builder. The government would still get considerable experience about \$5 million in transportation fees. The VTOL-powered version had a development contract limitation of about \$11 million although not all the money has been spent. About \$20 million was spent on the third phase of development.

Westland Aircraft and that without the RAF and BEA orders, it did not feel justified in continuing the project at a private venture despite letters of interest from abroad. Korean Aircraft Corp. is the U.S. licensee.

The company added that the Rotodyne could not have contributed to profits for at least five years and that the cancellations will have no adverse effect.

### Atlas E Launched

An Air Force General Dynamics/Astronautics Atlas E ballistic missile was successfully launched from the missile launcher operational system and tested at Vandenberg AFB, Calif. last week.

It was the second to test the first successful launch from the Redwood, an inert, mobile launcher. The missile was prepared, stored in the vertical position and launched in a joint operation by personnel from General Dynamics/Astronautics, AFSSR Aerospace Test Wing of Air Force Station, California, and the 34 Strategic Aerospace Division of Strategic Air Command. The Atlas under Atlas E22M, the E version is equipped with inertial navigation and its engines develop 160,000 lb thrust each; the Atlas E22M is about

100,000 lb thrust each; the Atlas E22M is about 100,000 lb thrust each.

In addition, Westland said it will receive certain patents from American firms and will be able to release considerable sums previously written off. Several million dollars previously earmarked for future Rotodyne development will be used for other projects.

The end of the Rotodyne leaves the concept of fielding the Rotodyne on routes known as the Boeing and Jet routes at the Thurston air display (AW July 17, p. 24). Those routes would use S-300.

The Rotodyne originally was designed by Fieser Aviation, where helicopter interests were merged into Westland in February, 1963. The prototype was developed under government contract with the Ministry of Defense, 1957 and Fieser continued the project as a private venture. Maiden flight was Nov. 6, 1957.

MacArthur, D. Napier & Son, builders of the engine, had dropped the engine as a commercial proposition after a review of its prospects. The engine powered the Canadian Canard 540, some of which are in service with Royal Canadian Air Force. An engine development plant, Napier said, must come from within funding.

## Boeing 1961 Sales Up; Douglas Reports Profit

New York—Douglas Aircraft Co. showed a profit during Fiscal 1961 for the first time since 1958 and the Boeing Co. announced high profit and sales over the previous year, annual financial reports of the two companies have revealed.

Douglas reported a net profit of \$7,977,000 or \$1.55 per share for Fiscal 1961, which ended last November 30. This compares with a loss of \$19,428,000 or \$5.99 per share for 1960. The company reported sales of \$791,312,000 in Fiscal 1961, compared with \$1,747,000 in Fiscal 1960, and had a net income of \$7,977,000, compared with \$1,550,000 in 1960.

Boeing Co. sales, returns, for Calendar Year 1961 reached \$1,800,910,000, compared with sales of \$1,551,573,000 for 1960. Net earnings for the year were \$35,661,000, representing a return of 1.6% on sales and capital to \$4.47 per share. Earnings in 1960 were \$26,662,000 or \$3.07 per share.

Trended backlog in Boeing totaled \$1,364,700,000.

### Apollo Attitude Control

Los Angeles—Matsushita Corp., Van Nuys, Calif., has been selected by North American Aviation's Space and Information Systems Division to design and build the attitude control system capable of attitude control of the NASA Apollo spacecraft.

The installation, part of the overall stabilization and control system to be supplied for Apollo by Minneapolis-Rosemount, will operate for the Apollo service capsule in the trajectory from earth to moon and return, and for the command capsule during standby in earth's atmosphere after the service capsule is jettisoned. Control for the mission control system will be in excess of \$5 million.

## B-58 Ejection Pod Makes Manned Test

Fort Monmouth flight test of Convair B-58 crew ejection system was made successfully last week near Edwards AFB, Calif., with the supersonic bomber traveling at 500 mph at 20,000 ft altitude.

The test, which involved proving time 10,000 ft, thrust, tested the Stanley Aviation Corp. helicopter-like capsule, containing USARF parachute test crew. Westcott Officers Robert J. Mason, about 210 lb, and John C. Collier, about 170 lb, were ejected.

After a 36 sec, 1,000 ft fall, the B-58 crew ejection device opened the B-58 nose chute that lowered the capsule to the ground. The capsule is being eight minutes in the air.

The 400-lb Stanley crew ejection capsule will be fitted in all three crew positions in standard B-58s following additional tests of higher altitudes and supersonic speeds.

## Teamster's Sikorsky Victory Is Voided

New York—National Labor Relations Board has upheld an Independent Air Craft Guild-Sikorsky Aircraft Division of United Aircraft Corp. appeal against the Teamsters Union's Dec. 19 decision voiding the Guild.

Compacting with the Guild for representation of Sikorsky's 5,000 hourly rated production, inspection and maintenance employees at Sikorsky's Stratford, Conn. plant, the Teamsters won the election with a 97 vote plurality (AW Dec. 25, p. 22).

Both Sikorsky and the Guild filed an appeal with NLRB Regional Director John C. McLaughlin contending that the Teamsters had been guilty of misrepresentation prior to the election and asking that the results be voided.

## Webb Sees U.S. Lunar Landing in 1968

Washington—Riding an orbital rocket rather than on a direct flight to reach the moon program, to meet two years and one month to a lunar landing is early in 1968, the head of the National Aeronautics and Space Administration last week said.

NASA Administrator James E. Webb also told the House Science and Astronautics Committee that he agrees to spend about \$35 billion over the next 10 years with 120 flights of that game for manned space flight. For Fiscal 1961 NASA is asking Congress for \$8.8 billion and \$2.5 billion of that amount is allocated for manned space flight (AW July 3, p. 20).

Webb said the 1964 lunar landing could be made if all went well in the Apollo program over the next few years. If immediately differentials are encountered, he said the lunar landing would be delayed until 1970. He stated that the space agency has not abandoned the New program (see p. 24) but one must wait until the orbital rendezvous technique in the next successive weeks, including the lunar landing. It often allows the capability of saving something like two cost of time.

House space committee hearings on NASA's Fiscal 1961 budget continue in New York before special subcommittee established to consider specific portions of NASA's budget.

There were major points made by Webb and Robert C. Seamans, Jr., NASA's associate administrator, at last week's hearings.

**Solid propellant.** NASA currently is discussing with Defense Department officials the solid motors over 120 in diameter which will be needed for

the space program. Webb said that NASA's fiscal 1961 budget would include 215 to 240 in diameter (see p. 20). Seamans and NASA will use Defense development to solid motor "which required no program."

**Additional astronaut.** Webb said NASA expects soon to make "some additional" in the present group. He said the agency is studying ways to assure that manned space participants, even though 10 years with 120 flights, will be able to meet the needs of the program. Good consideration should be given to training test pilots in acceptable observations.

**General.** Webb said the vehicle will be doing much more than in the past year of 1961. Seamans said the program in Fiscal 1961 will cost \$201 million, compared with \$11 million for 1960, and 1964 mission for Apollo. Second Seamans said it is "a crucial step through initial development" but a program is made to increase its payload from 150 to 240 lb and to provide greater engineering security. Improved checks should be available by 1963. Modifications will cost \$8.5 million in total 1963.

**Orbital space observation.** Four flights are planned for 1961 and 1963 (AW Feb. 10, p. 17). Flight of the orbiting astronomical observatory will occur in late 1963 and early 1964.

**Electric propulsion.** Seamans said that of \$20 million, experiments are necessary to proceed with development of electric engines in the within year. Seamans said \$20 million is being directed to provide 10 to 60 lb of electrical power with the 10 lb, which will be under development. Flight tests in 1965 or 1966.

Seamans said long life ground tests including 10,000 lb of continuous vibration should be completed in 1966 or 1967 after which \$20 million would be used for long duration flight tests.

**Atmospheric research.** Seamans said that NASA's largest program in the future is working with Defense on aircraft development designed to fly fast in low altitudes for close support of ground troops.

## GE Unit Centralizes Defense Operations

Washington—General Electric Co. has established Defense Program Operations with headquarters in New York, to provide a single contact point for its customers in the aerospace and defense fields and to increase its activity in these fields.

Robert J. Brown, former general manager of GE's Heavy Marine Electronics Department at Syracuse, N.Y., will head the new office. It will have a staff of 100 and will report to J. Edgar G. Brown, president and group executive for the Electronic and Flight Systems Group, which includes the defense electronics, flight propulsion and electronic communications divisions.

The Defense Program Operations will have regional offices. Heads of these offices will have the status of department managers. The new office will have a staff of 100 and will report to J. Edgar G. Brown, president and group executive for the Electronic and Flight Systems Group, which includes the defense electronics, flight propulsion and electronic communications divisions.

The new organization will attempt to coordinate field activities of research, development, production and manufacturing complex covering about 75,000 people, including 10,000 contract and subcontract.

This new package of the new organization is to provide better customer-company contact, provide better customer service, including a systems management service, and coordinate working in the field and to increase GE's share of the aerospace and defense market, Brown said.

Washington also shows in the location for the headquarters which will consist of less than 150 to 200 people, more than 100 in contract or program management to GE facilities in New York, New York, Cincinnati, Ohio, Philadelphia, Pa., etc., than before general agencies are located here, he said.

## Apollo Fuel Cell Contract Imminent

Los Angeles—Selection of a contractor to develop the fuel cell power system for the National Aeronautics and Space Administration's Apollo spacecraft may be made this week by North American Aviation's Space and Information Systems Division principal contractor for the Apollo program. Candidates in the competition are Pratt & Whitney General Electric, Alco-Chrysler, and the team of General Motors and Ford.

The system is expected to be proposed for a two-week operational period, but that requirement may be relaxed to 10 days.

Webb said the development of a fuel cell under development limited to military and space applications, from Pratt & Whitney Division of General Motors, Inc., N.Y. The development was designed as a fuel cell and a high temperature hydrogen fuel cell, which could be used as an engine or electric.

The General Electric development is a low temperature, low pressure technology, which is the one technology currently being developed. General Electric also is working under contract with Air Force Systems Command's Aeronautical Systems Division development of a 100-watt fuel cell with a 100-watt operational life, probable in an earth-orbiting vehicle, to power facilities of fuel cell applications.

Alco-Chrysler development was a direct result of an of electrolyte, probably potassium hydroxide, retained in a bed of inert material between the electrodes.

The team will be developing a high temperature, low pressure hydrogen fuel cell, which could be used as an engine or electric.



31



Compiled by AVIATION WEEK from airline reports to the Civil Aviation Board. It includes excess baggage

## AIRLINE OBSERVER

►Seven major airline unions at Trans World Airlines have formed a Council of Air Transport Unions, pledging central support of any striking member. Representing an estimated 10,000 employees, the council includes the Air Line Pilots Assn., Air Line Dispatchers Assn., Flight Engineers International Assn., International Assn. of Machinists, Air Line Employees Assn., Air Line Negotiators Council and the Air Line Stewards and Stewardesses Assn. (One year ago a similar council was formed at Eastern Air Lines by FEA, ALSEA and IAM.)

►Eastern Air Lines will test a new series of radio programs designed to provide air travelers with information on current weather, traffic and other conditions which affect airline operations. Initially, the 45-sec. programs will be broadcast over local radio stations in Washington, New York and Miami at 6, 7 and 8 a.m. on Feb. 10, 11 and 12 p.m.

►Aeroflot has indicated that later models of the two-seat Tu-124 medium-range transport may soon be ready in 70 passengers. References to be to the recently announced Tu-124A, which is slated to go in service next year (AW Feb. 19, p. 5). None of the cabin configurations of the Tu-124 hitherto revealed has a 70-seat capacity.

►Mayfield interests are seeking renewed attempts to prevent a heavy aircraft traffic diversion from Baltimore's Friendship Airport to Washington's age Dulles International Airport, now under construction at Chantilly, Va. Latest move is being made by Rep. Daniel B. Rostenko (D-Md.) who will introduce legislation that would release the Federal Aviation Agency of the responsibility of operating Washington National and Dulles airports. Rostenko charges that traffic at Washington National has been operating at absolute peak and under conditions which FAA would not tolerate elsewhere.

►FAA will require new or modified direct aircraft introduced into service by supplemental air carriers to fly 100 hr. in proving tests. In the past, supplemental has been exempted from this requirement enforced upon scheduled carriers on grounds that most aircraft brought into use by supplemental had already been operated by scheduled airlines. FAA is raising the rule because certain supplemental carriers recently have put into service newly constructed or substantially modified aircraft.

►American Airlines experience with electronic data processing has brought out these facts, according to William J. Hughes, the airline's executive vice president: future application development time will be longer than indicated by first estimates—perhaps by second and third estimates; aircraft usage may come up to expectations; and immediate demands upon the equipment by operations, if not stopped quickly, can result in substantially increased development and machine costs.

►Brazil and the Republic of Guinea have signed an agreement providing for the establishment of an airline between the two countries. A pact between Aeroflot and Air Guinea calling for reciprocal services was signed at the same time.

►Justice Department has told the Civil Aeronautics Board that the proposed International Air Transport Assn. North Atlantic group laws (AW Feb. 12, p. 38) raise "such substantial questions affecting the public interest" that there is a need for full evidentiary hearings before approving the laws. Justice said that since group laws are not "non-discriminatory," the possibility exists that such laws are discriminatory.

►IATA will strengthen policing of rules governing accredited travel and ratings agents. New procedure will enable IATA to travel accreditation of an agent based partly on references within 60 days after a complaint has been lodged. Previously, it has taken as long as six months to process even minor complaints. Effective June 1, an agency compliance committee will be empowered to cancel an agent's application if it is found that the agent is unable to properly advise, improperly split commissions with other persons or made misstatements in applications for reduced rate transportation.

## SHORTLINES

►American Airlines reports it has 353.1 million passenger miles in January—a 7% increase over January, 1968. Air cargo flown during January totaled 11 million tons while a 20% increase over the same month last year.

►British Overseas Airways Corp. will implement its Comet 4 jet services in Asia with Rolls-Royce powered Boeing 707 aircraft late this month. Boeing 707s will leave London twice weekly for Hong Kong via Beirut, Teheran, New Delhi and Bangkok.

►Delta Air Lines reported a net income of \$470,000 for January, compared with \$351,000 for January, 1967. Operating revenues for the same two months, respectively, were \$14.3 million and \$12.3 million.

►Flying Tiger Line reports CL-44 transport aircrafts are adding an average 38 tons of cargo between Tientsin, P.R. and Tokyo, Japan in 15 to 19 hr. Flying Tiger says it is, in fact, a 1954H Constellation are carrying 38 tons with a flying time of 25 to 26 hr. on the same route.

►International Air Transport Assn. reports passenger traffic over the North Atlantic has doubled during the last five years. Passengers totaled 2.1 million in 1967, compared with 1 million in 1957. During the same period, air cargo shipments have tripled.

►North Central Airlines posted more than \$1.2 million in cargo revenue—including freight, express and mail—during 1967, its company reports. North Central claims it is the first land service carrier to log \$1 million in annual cargo revenue.

►South Pacific Air Lines will begin scheduled service to Samoa on May 18. Samoa will be served on the return leg of SPAL's Honolulu-Tahiti route on a bi-weekly basis. Part-time flights from Honolulu to Samoa on Tahiti will be 5-600 and economy class will be \$312. SPAL will continue to operate its Honolulu-Tahiti service on a weekly basis.

►Trans-Texas Airways' "round dollar" fare plan (AW Feb. 12, p. 47) went into effect late last month with Civil Aeronautics Board approval. The plan allows the airline to round off its new fares, which add the most 7% increase, to the nearest lower dollar. Under the plan a \$13.38 fare would become \$13.

## LOH/HUGHES—just what the commander ordered

The Army's Light Observation Helicopter will bring the latest state of the art to front-line reality. Men who must depend on the LOH will value the advancements the Hughes HO-6 provides—reliability throughout the mission spectrum from combat recon to logistic support. Greater performance and larger useful load capacity at a lower over-all cost. ■ The HO-6 rests on sound concepts which take full advantage of Hughes' modern techniques. These have been developed during the long partnership in progress between the U. S. Army and the Hughes Tool Company. ■ When deliveries are made, the Hughes HO-6 will prove itself—the optimum result of experience, imagination and outstanding production capability.

**HUGHES TOOL COMPANY—Aircraft Division, Culver City, California**



A salute to the 50th Anniversary of Army Aviation—June 6, 1968



Hughes has one of the industry's largest production facilities—in volume production of the commercial HO-6.



Hughes HO-6 blades quickly fold for easy dismount.



Compact size and small rotor diameter permit the Hughes HO-6 to operate from tight quarters.

## Lunar Altitude Measuring System Devised

By Philip J. Klaus

**Utica, N. Y.—**Simple, lightweight scheme to enable a lunar vehicle to accurately measure its height above the moon's surface at altitudes out to 200 mi. or more for personnel lunar orbits and landing trajectories has been devised here by General Electric's Light Military Electronics Dept. (LMEED).

Computer studies indicate that this technique, dubbed "Mark Twain," offers important advantages over conventional radio/radar altimeters in accuracy, operating range, size, weight and power consumption. These studies suggest that the system can measure altitudes (down to zero) with an error of only several feet at altitudes of 200 mi.

General Electric recently presented the concept to the National Aeronautics and Space Administration in an effort to obtain government support for continued studies. Work to date has been company funded.

### Brief Principle

The basic principle used in Mark Twain is an adaptation of one employed in the radio altimeter system developed by GE for the early Atlas ballistic missile.

In the Atlas radio altimeter guidance system, a signal is transmitted from the ground to a transponder on the missile. Because of the missile's velocity with respect to the terrestrial transmitter, the frequency of the signal is received

by the missile differs from the transmitted signal frequency by the amount of the Doppler shift.

The missile transponder then doubles the received signal (or shifts it to some other multiple) and transmits back to the ground. Upon its arrival there, the wave's transmitted frequency has undergone an equivalent Doppler shift.

In comparing the received signal frequency with the original transmitted frequency, and making allowance for the transponder multiplexing, the ground station can compute the Doppler shift and from this determine the missile's velocity.

In integrating the rate of change of missile velocity from time of launch, the ground station computer also can determine the total distance traveled by the missile, or its altitude.

In the Mark Twain system which GE proposes, a simplified radio/radar version of the Atlas ground equipment would be installed in the lunar vehicle. The counterpart of the transponder as used in the Atlas system would, in this new application, be carried aboard the space vehicle and later would be ejected in the vicinity of the moon.

Depending upon the vehicle's initial mission, the new transponder beacon can be ejected in an orbit, a ballistic trajectory, and request on the moon's surface, or to follow the vehicle's original orbit, trajectory to serve as a reference marker for vehicle guidance.

In either case, the vehicle home equipment integrates the rate of change

of Doppler shift to determine change of altitude between vehicle and the beacon.

If the beacon is ejected so as to re-point on the moon, the vehicle will determine change of altitude until the instant of impact, where the beacon would be destroyed, giving the crew an indication of its altitude above the moon's surface. If the beacon is ejected so as to remain in the vehicle's path until, the vehicle can take up a new orbit or initiate a landing maneuver, using the orbiting beacon as an altitude reference.

A vehicle making a lunar landing could place a beacon on the lunar surface and use it to determine vehicle altitude during the ascent-to-orbit phase of the mission.

The GE studies assume that the lunar vehicle will be equipped with a small digital computer for real-time guidance which also can be used to perform the required geometric trigonometric relationships from data supplied by the optical beacon.

### Weight of Device

On that basis, G. W. Wilson Means estimates that the vehicle-home transmitter-receiver and associated unit would weigh only 4 lb., not including power supply. Weight of the beacon to be ejected from the vehicle is calculated at between 3 lb. and 4 lb., depending upon whether it is intended to impact on the moon's surface and needs only one-litron battery supply, or whether it must



**Molelectronic AN/ARC-63 Emergency UHF Receiver Built**

Molelectronic AN/ARC-63 emergency UHF receiver built to demonstrate use of solid-state electronic techniques, weighs 0.46 lb., 40% less than standard ARC-61 version, and occupies only 9 cu. in. (A) The volume of a standard model. Power consumption is 2.2 watts to 26.5 watts for conventional ARC-61. The receiver, built by W. Christopher, Electric and Astronautical Systems Division, is a four-band AN dual-diode-tube, double conversion set. The RF and first IF stages use conventional vacuum components, while the rest of the set utilizes solid-state units. When standard ARC-61 uses 119 components, the new version uses only 62 standard component parts and one solid-state unit. Details are equipped at (1) AGC-1 level set control, (2) differential AGC amplifier, (3) two-stage AGC amplifier, (4) speech control, (5) AGC-2 level set control, (6) 10 KW coupling capacitor, (7) audio amplifier, (8) 0.47 VU coupling capacitor, (9) audio power amplifier, (10) volume control.

function for an extended period in orbit.

Using phase-lock techniques and assuming a 10 db noise figure both for the vehicle-home and ejected beacon units, Means claims that 100 milliwatts of transmitter power should provide operating ranges up to approximately 200 mi. with a 6 db signal-to-noise ratio.

Prior to beacon operation, its voltage-controlled oscillator would be phase locked to a crystal-controlled oscillator in the vehicle's system. The vehicle might, for example, transmit a continuous wave signal at a frequency of 1,125 mc. Upon receipt of this by the beacon, it would be heterodyned down to 121 mc. (plus Doppler shift) and used to control the beacon's oscillator whose output would be multiplied by a factor of eight and transmitted back to the vehicle at roughly 1,000 mc.

### Unconventional Radiation

The probable beacon could be pointed in a spherical form with a diameter estimated at approximately 31 in. It would be similar control to provide a ground guide for two such altimeters which would provide nearly omnidirectional radiation. The number of such beacons carried by a lunar vehicle would depend upon its intended mission.

Both the beacon and the vehicle home comparison equipment would be fully contained in a single altimeter. Means estimates the power consumption of the beacon at around 20 watts with a figure of

about 25 watts for the vehicle equipment.

Means claims the Mark Twain approach to determining altitudes above the moon has a marked advantage over conventional radio/radar altimeters in such important factors as range, accuracy, size, weight and power consumption.

### Altimeters Compared

For example, one existing radio altimeter built for altitudes up to 50,000 ft., requires 270 watts of power, is designed for maximum altitude of only 12 mi. and has a system response of 21 ft. plus 0.025% of altitude. Compared with the airborne radar altimeter release of 1,000 or so, Means

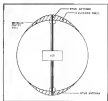
estimates the radio/radar version of Mark Twain can be built in a volume of 20 cu. in.

Potentially, Mark Twain should be more reliable, Means says, because it is considerably less complex than a conventional radio/radar altimeter. Because of its small size and volume, duplicate equipment could be carried to afford built-up protection.

In the next development, to NASA, representatives of GE's Light Military Electronics Division indicated that the company could conduct the detailed study of the use of such a system for lunar orbit, transfer, landing and takeoff, and make a preliminary design of the required hardware in less than six months.



"MARK TWAIN," new lightweight, simple technique to enable lunar vehicle to determine its altitude above the moon's surface, or change its altitude from impact trajectory, uses small continuous wave radio beacon ejected from lunar vehicle. Beacon can be ejected (A) so as to impact on lunar surface (B), making vehicle's ascent or orbit, or beacon can be ejected in orbit (C) so as to remain in vehicle's path until vehicle begins descent to transfer into lunar orbit. Ejectable beacon, rigid, containing glass-enclosed transmitter, would be housed in spherical container. Meltible casing and two thin antennas would provide nearly omnidirectional coverage. Studies indicate Mark Twain system offers significant advantages over conventional altimeters.



## Estimated Shipments of Electronic Components

Component	Second Quarter 1963		Year	
	Quantity (Thousands of units)	Value (\$Million plus one million)	Quantity (Thousands of units)	Value (\$Million plus one million)
Resistors	32,000	200,000	600,000	271,120
Capacitors	13,144	10,000	25,000	47,000
Diode crystals	500	1,700	1,000	4,700
Diodes	1,400	1,700	10,000	47,000
Transistors	40,000	60,000	20,000	80,000
Transistors and diodes	1,000	8,000	10,000	47,000
Power and signal processing tubes	700	1,000	1,000	4,700
Rectifier tubes	5,000	10,000	10,000	47,000
Electron-ray devices	11,000	120,000	600,000	271,120
Total				

# Mobile Traffic Control System Studied

By James D. Hordich

Blomson Field, Mass.—Pratt, an Air Force Systems Command project, is studying the feasibility of a mobile traffic control system to support the USAF's 4821, Emergency Mission Support System—a compact, air transportable collection of air traffic control equipment designed to meet an airlift and landing operation at landing strips in remote areas of the world.

An Air Force Systems Command's Electronic Systems Division has currently a pending contract to develop a ground-to-air traffic control system to support the USAF's 4821, Emergency Mission Support System. These companies will be selected to develop a contract award in late April or early May.

No dollar estimate is available as the contract, let by Col. Victor K. St. Johns, acting director of ESD's 4821 System Program Office, and it will call for production of three complete systems to be tested simultaneously at a site near the prime contractor's facilities. If tests are successful, Air Force plans to order 70 system packages.

The 4821 system is scheduled to be in operation by late 1971, and is currently being tested at the USAF's 4821, Emergency Mission Support System, which is currently being tested at the USAF's 4821, Emergency Mission Support System. The system is scheduled to be in operation by late 1971, and is currently being tested at the USAF's 4821, Emergency Mission Support System.

## System Concept

System concept specifies an area of operation and a communication system to be used to control the C-130A transport aircraft. The system is designed to be in operation by late 1971, and is currently being tested at the USAF's 4821, Emergency Mission Support System.

Support equipment and personnel would be carried in either an aircraft or on the ground. The system would be installed in the C-130A and would be used to control the aircraft in the area of operation.

Other system requirements include:

- Operation under extreme climatic conditions.
- Self-maintained operation for at least 70 days.
- Maintenance: maintenance, since remote airports could exist. Frequent replacement of spare and maintenance personnel prohibited.
- Operational maximum of 100 ft ceiling and low visibility, although setting of limits will be left to the discretion of the local commander.
- Capability for handling various air craft types, from supersonic jets to subsonic piston-engine or VTOL, including
- Landing rate of one plane every 21 min. System development efforts point

out, however, that a one per minute rate is possible over short periods with results of similar approach and landing speed characteristics.

• **Simultaneous control capability** for as many as 10-24 aircraft.

Additionally, ESD has specified that individual 4821 components must be capable of independent operation if necessary. For example, should an accident in the United States or overseas lead to a traffic control facility in part or whole, 4821 gear could be deployed to the field to provide emergency support until regular facilities are restored.

To meet this requirement, ESD has awarded a contract to the Federal Aviation Agency to ensure that 4821 will be compatible with air traffic control techniques and equipment under development by FAA for civil use operations.

## Program Background

The 4821 program is an outgrowth of two earlier efforts of a few years ago, Projects Two Wheels and Four Ws. Both projects had the same general objectives, but consisted of a rough assessment of equipment then available. Field tests conducted by Col. van in 1970 showed that the radar system was severely and affected a poor landing rate.

East September Air Force stand in operation requirement for a mobile, compact and advanced company air traffic control system and created the 4821 SPO.

A preliminary ESD estimate calls for approximately 12 personnel to operate a 4821 system at full capacity.

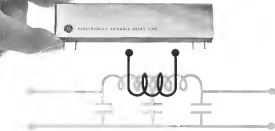
Edward St. Johns, ESD director, stressed that USAF wants a system that can be manned by "average" tech and personnel. We don't want to have to carry a lot of tech boys along as an operation."

St. Johns said companies that submitted proposals have been told "we want no more and no less than our specifications indicate. We can't change anything late, and anything might be too heavy or too expensive to be practical."

## System Components

No breakdown in equipment development is believed to be necessary for the 4821 system. Designated the AN/ESQ-47, the system is to include as basic components:

- Search radar unit (AN/TPS-15), consisting of a 100-mile range radar with a scan of 30 mrad at 45,000 ft, a radar transmitter-receiver, search display set for maintenance and independent use, and one UHF radio channel. The unit would be 12 ft long with one operator.
- Communications unit (AN/ESC-25), primarily for use by the base or theater commander would have long-range point-to-point communications part in full, the unit with USAF's mobile wideband 4821 Air Communications System, now under development. Equipment would include for air-to-air and various long-range intercept and



## SIMPLIFIES THE CIRCUITRY NEEDED TO CONTROL DELAY

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Defense Electronics Division

# GYROS



This 60-page reference book describes the theory, application and testing of gyros, platforms and accelerometers. It also discusses, with some reservation, to protect our proprietary interest, several sophisticated concepts now being developed at Kearfott. It includes, for your convenience and ours, a tabulation of the equipment we produce in these various product areas. A copy of this book is available to you free of charge. Just drop us a note, requesting your copy.



**Double Platforms.** Essentially a cluster of gyros mounted within gimbals and allowing accurate sensing elements, double platforms perform the important function of having the gyro not only control the platform by means of a zero loop, but manipulating various arrangements of gimbals and gyros, a variety of platform types can be produced. They are used as reference elements and for stability measurements, error tracking, and similar devices in space.



**Inertial Accelerometers.** A typical form of inertial pendulum accelerometer utilizing a differential transformer pickup, a high gain capsule amplifier, and a DC permanent magnet bias circuit is available. This type of accelerometer, together with its amplifier, is a high gain null seeking servo in which the current flows through the force balance coil, established as voltage across a resistor in series with the coil, is directly proportional to the acceleration applied.



**Floated Rate Integrating Gyros.** Floated Rate Integrating Gyros are used where exceptionally high level performance is required. Should the total mass of a gyro wheel having an angular momentum of  $1.0 \times 10^6$  g-in. have a shift by as little as one micro-inch, a drift of 0.1% per second results. The difficulty in achieving ultra-high precision and no capacity is evident, and the necessity for extremely low drift gyros is of paramount importance.



**Vertical Sighting Elements.** The Vertical Sighting Element is essentially a high accuracy single or two rate electrical phase lock providing an electrical output proportional to its displacement from the local gravity vertical. Effectively a form of accelerometer it is suited for applications not affected by a major offset, by inertial accelerometers working open loop. Since it is a fine open loop transducer, unless stabilized within a control structure, it will tend toward fluctuations, producing a signal resembling the result of jitter and these spurious losses.



**Inertial Reference Platforms.** Designed for ballistic missiles, the three-gimbal configuration of the SOS10 Platform has undergone rigorous flight and sled tests, thoroughly proving its accuracy and ruggedness. These Kearfott inertial navigation gyros (KING) form the core of a velocity servo mechanism which provides dynamic isolation of the inertial reference from external inputs. These inertial-quality accelerometers are mounted on the isolated inner cluster. The resulting platform is a hermetically sealed cylinder 10 inches in diameter by 14 inches in height.



**Ring Floated Rate Integrating Gyros.** Designed primarily for missile system applications, the gyro enables possible the superior performance of the SOS10 platform. Distinguished by outstanding mass stability, eliminating the need for daily trimming, and an extremely low drift rate of 0.003%/hr, this gyro has all capability of being focused at rates up to 22,000%/hr. An optimum combination of characteristics permits tight gimbal control. A low impedance pick-off and DC torque virtually eliminate noise problems.



**Inertial Single Axis Accelerometer.** This single axis, fluid-damped accelerometer is a DC transducer device possessing a useful dynamic measuring range of greater than twenty g's. The sensitive element consists of a symmetrically-located differential transformer pick-off and a pair of force coils mounted in common on the instrument measuring arm. The high degree of symmetry of both force coils and pick-off coils minimize the resultant errors which might otherwise occur during vibratory inputs. TransistORIZED amplifiers, such as the Kearfott type S3503-03A, are available.

Typical characteristics include: Range of measurement . . . 20 g when using S 3503 amplifier (bias and zero stability . . . 0.00002 g day to day . . . Threshold . . .  $2 \times 10^{-4}$  g . . . Natural frequency . . . 220 cps.



**Vertical Sighting Element.** A frictionless, wire-suspended pendulum acts as the moving portion of two orthogonally mounted differential transformers to provide phase-sensitive ac output signals proportional to the tilt angle. A typical application is inertial alignment of a gyro platform. The unit has exceptional repeatability to vertical, high sensitivity, and low null voltages.

Design features include a balanced signal generator for minimum null shift with temperature or excitation - and for fluid filling for damping and resistance from shock or vibration.

Typical characteristics include: Linearity . . . 5% of 3 arc minute - Threshold . . . 0.5 arc seconds max. Null repeatability (long term) . . . Within 2 arc seconds.



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### B-52 Electronic Countermeasures System Simulator Shows

B-52 electronic countermeasures simulator for training ECM officers is able to simulate wide variety of enemy radio signals which require ECM operator must be able to find "real" simulator uses punched card system to select simulated enemy radio stations characteristics and other parameters of the radio, such as location, pulse, repetition frequency, pulse width and duration to B-52 jamming. During simulated training flight, signal activity varies continuously. Reported provides a greater record of student performance. The new simulator was built by Raytheon Electronics Inc., subsidiary of Universal Safety Corp. under S11.5 million Automated Systems Division contract. Close-up of student's position, which closely resembles B-52 ECM station, is shown at right.

transmission of weather information, operations plans and support data. The ram would be 13 ft. long and possibly mounted by four operators.

• **Power:** van (AN/TSM-46), 12 ft. long, would have full traffic flow capability with two controllers and a data handling operator. The van would include 18 air-to-air channels (3 UHF, 4 VHF and 5 HF). A Servo Corp. of America CRO 11 Doppler detection finding antennas mounted near the van, and light gun for signaling approaching aircraft.

Construction concept shows a central control, around the sides of the van up to four feet off the ground. During airfield, the control would be folded opened to protect the tower windows.

• **TACAN van (AN/TSM-47), 9 ft. long, containing a dual beam transmitter, dual receiver and automatic switches capability for extended operation. International Telephone & Telegraph Corp. already is building equipment of this type.**

• **RAPCON van (AN/TSM-5), 15 ft. long, mounted in one personnel. Equipment is to consist of two dual approach display radars, three surveillance displays and one large horizontal display radar. A 6-ft. long array van will contain 18 air-to-air channels (7 UHF, 6 VHF and 5 HF) and a microwave link to receive data from radar van.**

• **Fixed approach van (AN/VF-14), 12 ft. long, to contain a radar transmitter, a fixed approach display for emergency operations, two air ground-**

at channels (UHF-VHF), and a microwave channel linking it with the RAPCON van. Cable communications can be used instead of the microwave jam at the fixed approach and RAPCON vans are not widely separated.

The entire ABLE system will be powered by gas turbine engines weighing 450 lb. each and capable of speeds to 13 ft. 24 ft.

The radars were chosen, Sigint said,

because they are easy to question and "will learn just about anything you can find."

Each van will carry an extra turbine as a backup.

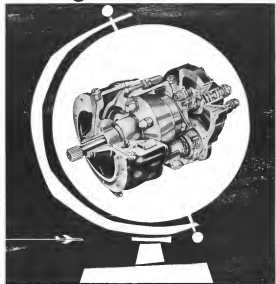
Thirty dual search of spaces will be stored internally at the van. Another 60 dual search van also be stored with each ABLE system package. Four maintenance vans will be as duty at each site.



### Antenna System to Work with Echo II

Developed system antenna system consisting of four 30-ft. diameter parabolic reflectors is designed to give performance equivalent to a single 60-ft. dish. Developed by Ohio State University's Antenna Laboratory under Rome Air Development Center sponsorship, the unit will be used in passive communications satellite tests with Echo II 15-ft. sphere to be launched this spring. The distributed system antenna is expected to be less costly and permit operation in a wider frequency range. Initial tests will be conducted at 2,800 mc, where one is expected to provide 49 db gain, but operation later will be extended into the 10-20 gmc range. Each antenna is powered by a 11 kw transmitter. Servo system to keep four dishes synchronized was built by Art's Inc., Worthington, Ohio.

# Throughout the world—



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## USAF Orders Four Vocoder Prototypes

**Dallas, Tex.**—Contract totaling \$578,100 for design, development and construction of four vocoder research-and-development systems utilizing coded digital transmission techniques has been awarded Texas Instruments Aerospace Division by Electronic Systems Division, Air Force Systems Command.

The four prototype equipments will be field-tested by Air Force to determine performance goals and specifications for digital Vocoder systems for operational use.

Aimed at providing a high degree of speech compression and communication security, the Texas Instruments Vocoder system will have three modes of operation—1,200, 1,400 or 1,600 bits per second—to reflect different degrees of bandwidth compression and quality and enhance compatibility with various available channel bit rates and open channel requirements. The digital output of the system may be used as an input source to automatic speech pattern recognition being developed by Air Force.

Cambridge Research Laboratories' Continuous-time Speech Laboratory. A fully automatic means of locking two or more duplex transmits into synchronization will be incorporated. Speech intelligibility, voice quality and talker recognition of the system will vary as a function of the data rate that of a voice channel at hybrid talk mode will provide a quality of the 1,600-bit mode, that is as good or better than full telephone quality, five bits

per second integrated event and subcarrier facilities. Since three vocoder modes active in the business probably would be selected if the program gets final Air Force approval, each perspective contractor has put together a team of experts including Fairchild Semiconductor, General Electric, Motorola, Westinghouse and Pacific Semiconductor.

**Shading Navigation Equipment** Wright-Navy hopes to cut the weight of airborne Lucas C receivers by an appreciable amount in a forthcoming program aimed at developing an experimental 18 lb Lucas C receiver. Weight reductions will have to be achieved through the use of one of the new techniques of microelectronics. Proposals for the Status of Weapons program are due on May 9.

**Channeling Lightning** Studies—Air Force Cambridge Research Laboratories plans to attempt to draw lightning channels in the test area by using a laser about lighting characteristics—such as frequency, potential, current and energy of the stroke, possibility of coupling energy to the channel channel formed in the test area. The study calls for firing into thousands of miles to which will be attached for the size of high tensile strength. The discharge can follow the size to the ground, or passing it and thereby cutting an isolated channel down which subsequent strokes could be channelled. The non-aid channel could provide service as an antenna for VLF transmission.

## \*\*\*\*\* FILTER CENTER \*\*\*\*\*

**► Integrated Circuits for Growth Measurement**—Electronic equipment programs to determine and improve the reliability of integrated circuits which would be used in the social guidance computers of growth systems of the Minuteman ICBM may be initiated soon by Aerospace Associates, general contractor for the ballistic missile's guidance and control systems. The program would be followed after a early within dollar Air Force/Aerospace effort which significantly boosted the main line to further of advanced discrete device components now going into Minuteman (AW Dec. 12, 1968 p. 98; Dec. 15, 1970 p. 65). The Minuteman that Aerospace will make this one is a reflection of growing Air Force confidence in discrete semiconductor devices, their absolute high reliability and low cost. Aerospace is preparing to send out bid packages to integrated circuit manufacturers to expand with their capabilities while the cap-

**► Lockheed Prepares THUGD Test**—Lockheed Martin & Space Co. is assembling an industry team, including jet engine, rocket, guidance/control contractors, in anticipation of a possible industry competition for a new launch vehicle to put operational Titan rockets into orbit.

Lockheed will use Titan rockets to put Titan rockets into orbit for use of Titan launch vehicles, but Aerospace Corp. is reviewing a number of possible alternatives, among them the Lockheed THUGD (Titan) launch vehicle. Lockheed, a new stage vehicle based on the solid propellant Titan launch vehicle (AW Jan. 7 p. 71). Lockheed said several aerospace companies in initial proposals rather than a small, lightweight to initial plans for THUGD. As yet, however, funds have not been allocated for an alternate Titan launch vehicle.

**► Extensive Adaptive Antisubmarine**—A modular adaptive antisubmarine light control system designed for advanced missile space vehicles, such as Aerospace Phase, separation, transport, TFX and VAX, has been developed by Sperry Phoenix Co. Working models of the system have deployed near-time-before-del-

ivery in excess of 1,000 lb. The dual-axis adaptive control system is lighter, more precise than those present for single axis systems, an advancement made possible by the use of "cardinal" computer components.

**► CAL Studies Perception**—Cals—General Aerospace Laboratories, which is emphasizing perception applications in its OSHA-sponsored studies, is using a digital computer to analyze perception operation in determining changes in original Mark 1 concepts which will enhance mankind's ability in character and target recognition. For example, CAL is investigating Perceptual, where as, sometimes with a bigger threshold value rather than one, used in the Mark 1. CAL's William Hildes reported at the OSHA conference. Another objective is to determine optimum configurations for using active users to automation units when the nature of the learning task is known in advance. The Mark 1 employed random wiring between input and output association units, which increases mankind's flexibility, but may also slow its learning process for certain types of tasks.

**► Bertram Bonded by New Technology**—Bertram can be bonded to itself by a gas-phase bonding process which exposed to a temperature of about 1,000°C and a pressure of 10,000 psi for two to five hours, according to studies conducted by Bertram's Molecular Interface Science Research Corporation. Details on the process are available in report entitled "Fundamental Studies of Bonding of Bertram-Chad Union-Chloride Fuel Elements," identified BMD 1545, issued at 50 cents, from Office of Technical Services, Commerce Dept., Washington 25, D.C.

**► Vintec Channel Increase Speed**—Federal Aviation Agency has awarded contract to ITT Federal Laboratories to investigate techniques for increasing power transfer of Vintec channels. One technique would use different pulse code spacing to double transfer of distance-minimum power transfer channels.

**► Silicones Grow in Thin Sheets**—Westinghouse Electric Institute has developed techniques for growing silicon crystals in sheets as thin as 0.1 mil, as thicknesses of 0.0045 to 0.015 in. and more than 7 ft long. The sheets, with smooth parallel surfaces, are reported to be free of crystalline defects and directly usable for semiconductor devices. The new technique is an adaptation of techniques for growing single crystals for producing thin silicon wafers, known as dendritic growth. The process uses a seed crystal that generates two parallel dendrites, which fill in from the sheet.



KAMAN'S H-43B (below), powered helicopter has become a mainstay of 74 local line units of the USMC (in Rescue Service). Relatively high

*Aviation Week Pilot Report:*

## Kaman's H-43B Helicopter Demonstrates

By Larry Books

Danbury, Conn.—Kaman H-43B (below) turbine-powered helicopter is a highly specialized vehicle whose vertical takeoff and landing capability, high lifting power, ease of control and a wide range of maneuverability increase rescue performance. It is the most versatile rescue aircraft in the U.S. Air Force inventory.

In operation the H-43B resembles a conventional helicopter, but its design features two intermeshing two-bladed rotors.

To the ease of control that distinguishes the concept from other rescue helicopters is added the further refinement of automatic revolution-per-minute regulation that distinguishes the turbine-powered aircraft. The result is a helicopter that is almost as easy to fly as a conventional airplane.

In the light of the above, the Air Force plans to use the ease of piloting as the one factor that often splits the difference between rescue and battle.



AT THE END of the collective pitch stick, shows the throttle control in a panel containing the master switch, engine speed governor switch, landing light On-Off, engine master switches and the fuel/ignition switch.



Using power, ease of control and wide range of maneuverability are reasons H-43B is used extensively in rescue missions.

## Wide Versatility in USAF Rescue Missions

The Aviation Week pilot evaluation of the aircraft which has become the standard of the 74 local line units of the USAF Air Rescue Service was conducted at the Kaman plant here, a short distance north of Hartford.

Adding to the distinctive rotor appearance of the H-43B is the oblong fuselage. Set on the bottom and sides, with a diamond door in the rear and clear plastic bubble in front. Two booms extending from the upper part of the fuselage support two vertical stabilizers. A movable horizontal stabilizer connects the vertical stabilizers and the booms. Each of the vertical stabilizers has a movable rudder attached to the side edge.

The exhaust pipe of the single turbine engine extends from the upper part of the fuselage between the booms and over the horizontal stabilizer. Topping the aircraft are the two pylons mounting the rotor blades and the engine mounted between them which are mounted on struts outside of the fuselage near each rotor. The front wheels are swiveling and the rear wheels are fixed and have brakes.

The H-43B is honest in its responses.



EXHAUST PIPE of the single turbine engine extends from the upper part of the fuselage between the booms and over the horizontal stabilizer. Topping the aircraft are the two pylons mounting the rotor blades and the engine located between them.





## AT RADIATION, CHALLENGE IS OPPORTUNITY

*Example: PCM telemetry for "Nimbus"*

Accurate long-range weather forecasts will be more's the need to live against the caprice of the elements. The Nimbus meteorological satellite system—being developed by the Goddard Space Flight Center of the National Aeronautics and Space Administration—will improve such forecasts.

Radiation Incorporated was selected by NASA to design and build PCM telemetry for Nimbus. The requirements posed a challenge of system long life and high reliability that have led to major advances in the state-of-the-art. For Nimbus a new concept of power switching was developed that will result in a power saving of 301 awr. present methods. Other Radiation-built ground systems will process Nimbus data.

Nimbus, Telex and GAO (Orbiting Aeronautical Observa-

tory) scatter PCM systems are but three of the many existing projects in which we are presently engaged. If you're the kind of engineer who is stimulated, not dismayed, by the myriad challenges of space electronics, you'll find kindred spirits of Radiation Incorporated. If such an environment appeals to you, and your resume or write for information to Personnel or either Dept. AN-32/Modest Incorporated, Melbourne, Florida—or equal opportunity employer.



**RADIATION**  
INCORPORATED

Continued on opposite side, opposite and pressure—Automatically shutdown—Automatic system



**KEY TO THE RAGS OF CONTROL** of the power to the rotor system is the Lycoming T53-L-11 turboshaft engine and its engine fuel control system. Engine is made up of a gas producer turbine which drives an axial flow compressor. Engine fuel is 30-4

to control movements. In making landings without power it is not necessary to first or pull up the nose in readiness as with other designs. This Avianator Wings pilot fuel control assembly and enabled the lower edges of the vertical stabilizers during an autorotation land up as the tail surfaces got too low to the ground.

It wasn't until after a cup of coffee in the lounge that it was realized that nobody was indoctrinated in the H-41B and such a mishap had occurred. In 30 sec. the light phase double bottom stabilizer edges had been replaced.

**Reverse Requirements**

In writing the specifications for a scout helicopter, the Air Force demanded an aircraft capable of rapid starting and capable to the use of a crash or other emergency, the ability to pick up survivors, fire control and navigation, and other features.

That it was built this mission is attributed to the fact that they are now more than 100 instances of rapid rescue action in the case of crashes in addition to many other types of crashes.

The pilot's seat is located at the right side of the forward cabin compartment. All controls are arranged within easy reach of the pilot and the instruments are located on a mirror panel in the middle of the compartment forward.

A console running all from this panel contains electrical and radio switches, which will be described later.

A captain's seat can be installed at the left of the pilot's seat. For the basic crash rescue mission the configuration consists of an instructor's seat and two litter or cot rest compartments. With the litter compartment, up to six seats can be installed in the rear compartment. A boat is provided for rescue work and an external cargo

back can carry fuel-fighting packages.

Gross weight of the H-41B for a typical rescue mission is 7,000 lb., which includes the pilot and crew members.

Key to the ease of control of the power to the rotor system is the design of the Lycoming T53-L-11 turboshaft engine and its engine fuel control system. The engine is made up of a gas producer turbine which drives an axial flow compressor. Compressed air flows into combustion chambers. The hot gases produced first turn the gas producer turbine and then the power turbine whose shaft is directly connected through the gas producer compressor to a reduction gear in the front of the engine. Power for the rotor is taken from there. Fuel for the engine is 30-4.

Since air is bled from the compressor to supply engine and wing fuel cells.



**RESCUE HOIST** for the H-41B is electrically operated and equipped with 120 ft. of cable.

Engine power is controlled by the position of the collective control stick at the pilot's left side. Power (torque, and, consequently rotor speed, are controlled. By moving the collective stick, the rotor blades increase their angle of attack and produce lift. With this application of load, the slight decrease in speed of the power turbine causes the engine fuel control unit to admit fuel into the engine to produce more power. Fuel flow is also automatically metered to compensate for changes in air temperature and pressure. These sensor features are dependent on the actions of two through-rotor sensors, one for the gas producer turbine and the other for the power turbine.

If the automatic fuel control system fails, the instructor can use the collective pitch stick, also, as a throttle (as in a piston helicopter). This is an emergency condition; the training associated with the piston helicopter, where pitch and power have to be manually controlled to maintain rotor rpm, makes such a task, a necessary but often risky and essential function.

### Instrumentation Location

At the end of the collective pitch stick, above the throttle control is a panel containing the starter switch, engine speed governor switch, landing light on-off and emergency master switches and the fuel/light switch.

Below entering the H-41B a manual self-contained inspection covers 16 ports and 40 items, including the rotor system, upper fuselage, pre-emptive valve sections of the fuselage, cabin interior.

In the cockpit there are 45 dials to follow in inspection and setting of controls and switches before starting the engine. Obviously, a crash rescue aircraft must have had this checklist in operation before going into an alert status.

Starting the engine is simple. During

the pressure checkoff but the fuel pump must have been turned on and the throttle rotated to the left out of idle cutoff. Pressing the starter switch for one second actuates the starting sequence. If the oil pressure does not reach 30 psi by the time the pre-ignition indicator reaches 40% or if the exhaust temperature exceeds 900C, the throttle must be rotated right to idle cutoff. Gas produces idle rpm is 420.

The robot are started by releasing the return handle lever. Upon increasing the throttle to flight idle and a gas producer type of 6.2% and breaking all connections with ground equipment the aircraft is ready for towing.

Slight movements of the cyclic control stick will make the aircraft move in any desired direction. Turning is done with the turn pedals. Since there is no tail rotor to create turning moments, the turn pedals are in effect additional cyclic pitch controls.

These cyclic changes are applied to the robot so that a circular locus is applied in a plane perpendicular to the vertical axis, causing the aircraft to turn. Collective pitch causes lift equally about the vertical axis and parallel to it. Cyclic pitch applies the lift unequally about the vertical axis, causing pitching and banking movements and twist (in the direction of the tilt of the rotor).

While tuning, it is customary to check the tracking of the rotor blade tips on each side. If one blade does not track the other in the other, then one is brought together by a simple adjustment. The result is smoother flight. Two holes are installed on top of the turn cords.

For takeoff, the throttle is moved to full open. The engine speed/governor switch is set at 88%. This can be changed according to the conditions of load and other variables. For lift-off, the collective pitch lever is raised gradually until the wheel starts to crawl. The cyclic stick is used to keep the aircraft level, and longitudinally level and the pedals to keep headed into the wind.

Flowing was tried first. A wind of about three knots was blowing, making rowing on one spot relatively easy. It was the maneuver that demonstrated the high degree of stability typical of the transverse row system. Height control was easy with the reflexive yank lever, while lateral and fore-aft control movements were easily controlled with the oarlock track.

The cyclic stick, has some artificial "feel" as it through use of adjustable springs. There is less tendency to over-control with it than in single-rotor helicopters. The turn periods require more than for hovering, less than for rotor turns of helicopters.

Clark is quite satisfied he cannot



HELICOPTER is fitted with four gun landing gear. Front wheels retract via landing gear on fixed.

the static stack, forward and increasing the collector stack pointer.

In final flight the collective stick can be locked in one position after a desired power setting has been made. Adjustments in flight then are made with the cyclic stick and the pedals.

The most noticeable feature, the ancient flight bagging, is a fine relatively weak but frequency vibration at times the most open. That "chasing" is much more pronounced than in other rotor systems. It is momentarily disconcerting but more guarded. For instance, especially there is not considered an acceptable feature, but is not likely to make passengers feel comfortable. By size of comparison, the new tandem rotor systems are relatively less stress in chasing and the single main rotor systems, e.g. the helicopter.

Claris optimum spora is 45 lit. Nucleolus mass is between 65 and 55 lit. *Mastomys natalensis* talpids can be



**VERTICAL STABILIZERS** of the 61-6102 have frangible plastic edges that can be replaced quickly at demand.

made by using 104% engine rpm... full up collector and considerable forward curve still there.

Turns during climb level flight and descent are almost like a winged aircraft. The same type of coordination between cyclic stick and pedals produces balanced bank and turn, with the ball in the turn and slip/skid indicator in the middle.

### London Procedure

The landing check is gone out; while descending. Distance is made at a speed of 90 to 55 ft. At about 75 ft altitude, the flare is begun. For a position on landing a boat is entered at 5 ft, and the surratt raised to the ground. A power off landing involves a flare at about 5 ft altitude and then come down at a landing on a level attitude with some forward speed. This procedure differs from other water systems where a nose high attitude is maintained for power-off landings, with little or no forward speed.

Running bindage can be made with power on at 15 to 20 lb.

Generally speaking, the greater the width of the H-HB makes it an easier behavior to fix. But as mentioned by

ble, a background of commercial pilot power training is advisable. The instructor is so used to it that the Navy and Marine stopped using the HTK-1 in their helicopter training program. Kansas pilot Ralph Lee demonstrated some high and tail-high maneuvers, low sights and other relatively mild acrobatics for helicopters.

Emergency procedures in the B-31B are essentially the same as in piston helicopters. Engine failure on takeoff or in hover will result in a hard sitting down with the collective pitch stick.

is to increase the setting the severity of what would be done at altitude in the event of a power loss.

During climb with forward speed, a second autorotative landing can be made using the principle of maintaining forward speed until the time to flare. Then use maximum flare and minimum flap procedures.

Rocket can be attempted in the air as long as the ambient gas temperature stays less than 500°C. Rocket could take as much as 1,000 ft. of altitude, so emergency landing procedures must be followed. In the event rocket cannot be accomplished, the fuel boost pump must be shut off, the ducts turned to cutoff, fuel nozzle turned off, and the bottom umbilical turned off.

As a result, the Hasko provides a number of methods of detecting, at sea and how to trust against electrical power failures. Auxiliary equipment of the Hasko includes heating and anti-fogging systems, communications systems and electronic display and behavior.

Citizens' attendance at the event



THE GATEWAY TO THE WEST has become the Gateway to Space. The spirit of St. Louis first lured pioneers westward in a struggle that unlocked half a continent. It nourished the practical dreams of Charles Lindbergh and he opened an ocean and an era. The spirit of St. Louis has now spread through all America, charting the course for a great new American adventure.

Mercury spacecraft, designed and built in St. Louis, have carried Astronauts Shepard, Grimes, and Glenn on their history-making flights. As this new national enterprise reaches toward the moon, it deserves the enthusiasm and support of every American. For the historic achievements of nations are but reflections of the courage of individual citizens who rise to meet great challenges.

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Oceanographic work at Westinghouse is directed by the Ordnance Division at Baltimore and backed by the Central Research Laboratories at Pittsburgh. Present accomplishments, and the promise of others soon to come, are examples of how science serves Defense at Westinghouse — Defense Products Group, 1000 Connecticut Avenue, N.W., Washington 6, D. C.

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## THE RECALCITRANT SAUSAGE

LEACH HERITAGE OF THE AIR—18

On his fourth try, emerging out of the early morning fog at 3,900 feet, the Belgian again fired at the kite balloons at point-blank range. And still the gun boys would not harm him. Instead, the sausage suddenly shot up, as if inflated of a great weight, and collided with the little Hanriot H.D.1 above. For a second the plane passed, pinned on its nose, then the pilot cut his engine as the balloon sagged and sank below him.

In the next minutes, the Hanriot plunged over the side, nose first, gathering speed as it fell. As the propeller began to spin, the

pilot opened his fuselage and passed his ship for home. The balloon, nose and landing, fell to earth and exploded in fire.

It was May 15, 1918—the day Willy Coppens, Belgium's greatest World War I ace, scored his fourth and most famous victory. He emerged from the war as Lieutenant Willy Coppens, D&D, M.C., with 37 kills, including 26 balloons.

The Hanriot H.D.1 Coppens flew almost exclusively had one major drawback. It was fitted with only one machine gun, cen-

trally mounted on the fuselage. To compensate for his restricted firepower, Coppens began his career as a balloon hunter with 25 precious rounds of secondary bullets which he obtained from a French source and hoarded by taping up an ammunition belt containing the secondary rounds, each interspersed by three ordinary rounds at the beginning of the belt.

The Belgian ace calculated that 50 yards was the maximum range at which to open fire and that after his approach down at 125 mph he had little time than a second to pull up and avoid collision. His victory over the recalcitrant balloons on May 15 cost eight of his precious secondary bullets, but they were because plentiful through official channels.

Considered by many pilots a delight to fly and tried seemed to ease his maneuverability, the humble Hanriot H.D.1 was powered by a 130 hp. Le Rhone rotary engine. Strong and quite light, the plane was designed with heavily staggered wings. It was extensive and successful service on the Western and Italian Fronts and a small quantity was manufactured in the United States for the Navy.

Willy Coppens' final victory coincided with his last patrol as shown on October 16, 1918. After expending one money balloon at 2,600 feet he moved to his next target, which had been reached down to only 900 feet. Just 150 yards from the target he encountered a barrage of anti-aircraft machine gun fire and anti-aircraft and incendiary phosphorus shells. Seriously wounded in the left leg by an incendiary bullet, Coppens bailed for his home five miles away. But one of his Hanriot's reduction paper had been hit and he was forced to land in a small field. The superstructure collapsed on landing, but Coppens was safe.

The brave Belgian spent months in a hospital, but even the loss of a leg could not keep him out of the sky. Willy Coppens flew again and became a widely known figure in postwar aviation.

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Technical Director for Heritage of the Air is Lt. Col. Kenneth S. Brown, USAF.

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...of these. Young executives grow near with MS&E or R&EE with former Federal Reserve or other accomplishments. In the art of high communication or security electronics, the atmosphere is ideal for the pursuit of our's specialized interests in the digital/analogue community of Acute, out of Pasadena.

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## Kaman Huskie Specifications

Displacement:	51 lb. 5.4 lb.
Span, side to side, with rotors opening:	47 ft.
Length, front to back, with rotors opening:	47 ft.
Diameter of each rotor:	47 ft.
Height over rotor tips:	35 ft. 6 in.
Height over rotor hubs:	13 ft. 7 in.
Clearance of rotor tips from ground on each side:	6 ft. 10 in.
Weight data:	
Maximum basic weight, including 44 lb. of trapped fuel and oil:	4,400 lb.
Maximum gross weight:	6,500 lb.
Maximum external load (single hook):	3,000 lb.
Engine:	
Rotating gas turbine:	753 L1B
Shaft horsepower:	500
Fuel consumption at sea level, 6,500 lb. gross wt.:	192 lb./hr.
Performance:	
Maximum speed:	185 kt.
Climax speed:	91 kt.
Range at island gross wt. of 4,100 lb.:	373 naut. mi.
Service ceiling at 6,500 lb. gross wt.:	21,150 ft.
Maximum rate of climb at sea level at 6,500 lb. gross wt.:	1,740 fpm.
Flare out of ground effect, sea level standard day:	3,500 ft.
Flare in ground effect, sea level standard day:	5,114 ft.

tion of the aircraft, however, is the equipment designed to be used in rescue work and carrying all cargo.

The aft rotor disk is equipped with radonax rings for cargo which can be loaded through an door in the side door of the cabin. This aft rotor is 58 in. wide, 57 in. long and 46 in. high. The radonax rings can be used to lift and auto maneuver in addition to cargo.

A cargo hook is located at the center of the belly of the aircraft. An external manual lock release permits the ground crew to attach the sling to the hook. The hook can be released automatically by a weight-sensing device which means the load when the weight sensed drops below 75 lb. as it would when the load is dropped on the ground. It can also be released manually by the attendant.

In the rescue search configuration there are two litters and an individual's seat installed in the aft cabin.

A major reason it is essential that anything raised by it can be brought down through the aft rotor disk door. The hoist is electrically operated and equipped with 100 ft. of cable. The cable feeds off the drum through a pulley mounted to a rigid tripod. A cable hook hook is attached to the cable by means of a dispenser which reduces shock loads, both to the helicopter and to personnel being rescued.

When the cable is fully up or down, the motor automatically stops the motor. An automatic brake holds the cable in any position where it is stopped.

If the cable should become entangled with ground objects or an any

other way snarled, a pre-engineered grabber cable cutter can be used to separate it from the aircraft. Up and down switches are provided on the pilot's cyclic stick and at the hoist operator on the attendant's grip. The pilot's manual overrides the attendant's control in the event of an emergency.

There are two external pingers available for the hoist rescue mission, a rescue hot lat and a dual-lighting equipment unit. The hot lat is carried in a motor deck and roll which is secured by straps to the aft wall of the forward cabin compartment. The lat contains a heater, 12-volt lights, radio unit, hydraulic air, harness, pings, an automatic of eight observation and safety pins. A crash sensor located lat is mounted on the back of the pilot's seat.

The dual-lighting equipment consists of a searchlight from top rotors which with rotating blades and heater motor. It is equipped with a flag that can be engaged with the helicopter's top hook, devalued down the rotor disk used to prevent lowering of the hoist during dark times at an airbase. The rotating blades are used to reduce heat as hot weather.

The gross weight of the catagatana is 1,000 lb. It is 15 ft. long, 6 ft. wide and 18 ft. high. It consists of a tank filled with water and from that rises a nitrogen tank and a hose with a nozzle. The compressed nitrogen is used to generate the tank through a pressure reducer, leaving the fluid through the hose and nozzle.

On tracking the atmosphere, the fluid expands to eight times its normal volume, permitting the 33 gal. of water

to yield 600 gal. of foam. The discharge can be used from a narrow to a wide stream by rotating the nozzle control. The discharge lasts 30 sec. or more.

The hoist-tower unit is in ground use only. Downward straps are released when the rotors are in rapid climb.

One of the most spectacular rescues performed by the H-119 took place at Laramie AFB, Wyo., where a Boeing B-52 crashed and burned on landing following an aerial refueling mishap. The helicopter hoist hook snook and burner vehicles so that ground firemen could effect a rescue.

In a different situation, a Huskie was sent to the site where a B-52 crashed had bailed out over a forest in New Mexico. The helicopter hoist hook snook 150 ft. from and lowered a single through the trees, using the helicopter's entire cable length, so that the aircraft man could be hoisted onto ground rescue points and sent back home.

In another instance three boys were rescued from a cliff in Arizona. The following records are held by the H-119:

- Airspeed for Vibration Aeromanepter Interceptor: 810 (ground speed) helicopter, 13,840 ft., Oct. 18, 1961. Certified by FAA.

- Altitude with 1,000 helicopter load: 26,165 ft., Oct. 18, 1961. Certified by FAA.

- Time to climb to 5,000 meters, 2 min. 44.5 sec. To 6,000 meters, 4 min. 43.1 sec. To 9,000 meters, 4 min. 11.5 sec. All seating configuration.

## Lockheed C-130E Meets Guarantees

Early flight tests of the Lockheed C-130E Hercules, designed to give transoceanic airlift capability with a 15-ft. fuselage, show that it meets performance guarantees. Lockheed-Georgia Co. reports.

First delivery is scheduled for April this year. The C-130E weighs 155,000 lb. compared with the 151,000 lb. gross weight of the current production model C-130H. Much of the weight increase comes from two external fuel tanks.

Powerplants for the C-130E are advanced Allison T56 turboprop engines driving Hamilton Standard three-blade propellers of 13.5 ft. dia.

At takeoff gross weight of 155,000 lb., Lockheed says the Hercules will have a takeoff ground roll of 4,350 ft. It will climb out at 1,500 fpm. Initial rate of climb is 3,000 fpm, or at 75 ft. per sec. Three turbo-prop engines are rated at 22,000 hp. In three regions, it is reduced to 17,500 hp. Cruise speed at 20,000 ft. is 361 mph.

More than 500 of the C-130E model aircraft have been ordered by USAF.

## BUSINESS FLYING



**TYPICAL OF THE ROOFTOP HELICOPTERS** in Los Angeles is this one on the roof of the Statler Hilton Hotel. (See story.) Helicopters, a helicopter has never, has extensive space to landing pad which is large enough to accommodate only one helicopter at a time. Similar landing pads are being prepared at the planning of many of the major buildings under construction in metropolitan Los Angeles.

## Los Angeles Helicopter Utilization Grows

By William S. Reed

Los Angeles—Eighteen per cent of the nation's helicopters are based in the sprawling, multi-colored Greater Los Angeles area and the probability is that this ratio will rise in the next few years.

The 6.5 million people living within a 25-mi. radius of the city center own 3.7 million automobiles, and the result is highway traffic congestion makes an ideal situation for helicopter utilization.

Large corporations make use of helicopters primarily for transportation of key executives from corporate headquarters to other divisions located in various areas. The large number of helicopters for corporate use are owned and operated by North American Aviation, Inc., which has 10.

Transport of key personnel from the corporate offices at Los Angeles International Airport to the Lockheed Division and the General Atomic Division at Santa Fe Park takes only 17 min. for a 28-mi. trip. The same trip could take 1 1/2 hr. by automobile, depending on the time of day. Ten of these and other distances to other North American divi-

sions such as Aerometrics in Anaheim is over quarter, making two of a helicopter now advantages.

Northrop Corp. has four helicopters, Hughes Aircraft Co. three and Douglas Aircraft Co. two. Three helicopters in the area have helicopter landing facilities and an application was filed with the city council recently for operation of a helicopter sublease service. Total number of helicopters in the area, including the 13 owned and operated by Los Angeles Airways, the helicopter airline, is 72. In addition to the 52 helicopters, there are 16 airports in the area in which helicopters can land.

A big boost to the use of helicopters in the Los Angeles area would be the establishment of a large downtown heliport. The Helicopter Committee of the Los Angeles Chamber of Commerce's Airport Development recently proposed 14 possible sites in the downtown area and nearby would be very likely prospect, a municipally owned parking lot near the city center.

After consideration of the parking lot site, however, the committee announced it would study the plan on the basis that it would create a more problem

and would cost valuable parking space, which already is at a premium. Also a consideration is that the costs would be about \$40,000 per month in revenue from the lot. Several other sites now will be investigated including consideration of use of the above sites located in the regional airport. Strong support for a public downtown airport is gained from high city and county officials who believe it is essential.

Construction of a downtown heliport would enhance the prospect market for Los Angeles Airways which operates 15 mail and passenger stops with Los Angeles International Airport. Los Angeles Airways has one downtown stop, located atop the Post Office building, but this service only for the pickup and delivery of mail and cannot handle passengers.

The helicopter airline so far has not been a big factor in the solution to the airport capacity problem, largely because of the expense and expense of the equipment operated. Los Angeles

**A new science-technology supports decision-making on a global scale.** How do you control world-wide forces when decisions must be made in minutes or seconds, based on huge amounts of information, which in turn must be literally up-to-the-second? Decisions of this scale are made possible by a new science-technology systems that provide information processing assistance for military and governmental leaders.

**Scientists, Engineers and Computer Programmers** at SDC have been on the growing edge of this science-technology since it began with SAGE (the first system of this type) and SACCs (the second system). Today Human Factors Scientists, Operations Research Scientists, Engineers and Computer Programmers at SDC are deeply involved in a number of new systems. Working in a close interdisciplinary manner, they are contributing to these systems in areas of: system analysis, system synthesis, programming giant computers, training personnel in the use of the systems, and in system evaluation. They are also carrying on research into future generations of these systems. What does this new science-technology offer you professionally? We invite your inquiry on this score of your ambitions, background and curiosity turn you toward this new field. Address **Dr. H. L. Best** at 2432 Colorado Avenue, Santa Monica, California. Openings are in Santa Monica, Washington, D. C., Paramus, New Jersey, and Lexington, Massachusetts. "An equal opportunity employer."



#### System Development Corporation



#### DECISION-MAKING ON A GLOBAL SCALE

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Systems that help men  
make decisions and  
coordinate control

Aerway has opened Sikorsky S-61s and an S-62 on its roster and while it looks in pounds of steel earned and in civil revenue collected, it has fallen far short of New York Aerway and Chicago Helicopter Aerway in the number of passengers carried. Figures show that for 1965, Chicago Helicopter Aerway carried 399,269 passengers and New York Aerway carried 146,775 passengers, while Los Angeles Aerway carried 79,194 passengers. However, the Los Angeles line carried last month a much smaller load as the Chicago operator sold three times as much in New York. Aerway figures for 1965 through the third quarter show a similar trend but the picture for 1967 appears to be quite different.

In December, 1965, Los Angeles Aerway took delivery of its first S-61 passenger, two turbine Sikorsky S-61H. The second was delivered in January and a third aircraft will be delivered this month. A fourth S-61 will be delivered in April and a fifth will be delivered at some future date.

With the carrying capacity and extra speed of the S-61, the Los Angeles line estimates it can begin to accommodate more of the traffic which heretofore has been largely ignored because of a lack of capacity.

Arrival of the S-61s have meant to have presented some problems, which were not known earlier. Los Angeles Aerway has been delayed in getting the big helicopters into service precisely because of the need to satisfy government regulatory agencies as to the suitability of operating methods and airport facilities. Not only was the authority delayed in issuing letters-of-no-objection to put them into service last summer (AW Aug. 15, p. 42)—but other obstacles such as the question of facilities has delayed introduction into service.

Further exploration of the helicopter's usefulness undoubtedly will come when a convenient, large downtown helicopter is available for the use of both small, privately owned machines and the large commercial craft operated by the helicopter airline.

More than one such helicopter is needed within the area, however, because Los Angeles does not have a regional airport as is the case in New York and Chicago. Even so, construction of a heliport in the downtown area would open helicopter sight, and public interest in studying marketing areas will follow in a natural course, city planners believe.

Non-scheduled helicopter bus service is available in the Los Angeles area between downtown airport facilities and International Airport as well as other area airports and approved landing areas. By maintaining a central scheduling, arrangements can be made for pickup and delivery at a specified time.



**BILL 472 HELICOPTER** terminal for a landing on the rooftop helipad of the recently completed Bill 472 Building in downtown Los Angeles. Building is 14 stories high and replaces the Los Angeles skyline. Flying time to International Airport is 5 min. Travel by surface transportation takes 30 to 45 min for the 20 min trip.

by Helibco, Inc. Fares are close to those charged by taxis. Time, of course, is the advantage Helibco offers, particularly for trips between downtown hotel locations and International Airport.

First commercial rooftop heliport was opened by Helibco owner Bruce McNeil who has provided his own financial backing for the venture through McNeil Construction Co. McNeil's early efforts to obtain permission from the city for building a rooftop landing site met with skepticism, if not open disapproval, he said.

Enforcement of city ordinances disclosed that helicopter operations are prohibited in industrial zones and McNeil determined that part of the city truly located Pacific Electric building was within such a zone. Construction of a heliport atop the Pacific Electric building was approved in accordance with fire department regulations and Helibco started service in February, 1966.

Since then, McNeil has constructed four other heliports and has more in the planning stage. Downtown rooftop sites are located on the Biltmore and Waldorf-Astoria hotels. Another site is located on the first lawn of the Ambassador Hotel and the roof of the Arroyo Vista Building on Pasadena.

Each of the rooftop sites, and the area landing pad, were built by McNeil without cost to the property owners. In return for his estimated \$10,000 investment in a rooftop site, McNeil gets exclusive rights to use the pads for the operation of Helibco. The company operates four Bell helicopters.

Economics of the operation are a long way from creating a profit. On a typical day at about 80 c.m., the flight schedule showed 17 flights loaded for a total of 19 passengers, indicating a low load factor. Traffic was at about 500 passengers per month, a figure which McNeil says will rise to 1,000 per month within a year. He also expects that, as



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the service catches on, the lead factor will increase and future non-stop flights will have to be made in the net counts for deadheading decreases.

McNair bases its great focus in the number of helicopters operating in metropolitan Los Angeles in the same close future.

#### **Costly Operation**

Three factors debate a slow growth in the use of helicopters as they now are being used, McNair states:

- **High cost of equipment.** The Bell J35 and H4 used by Robinson's service at about \$64,000 apiece. Added to this is the cost of engine overhaul, maintenance equipment and direct operating costs for 1,000 hr. per year flying time.

- **High cost of insurance.** Bell must now take losses annually to about 14-16% of the value of the aircraft. This amounts to about \$7,000 per month for each of the operating helicopters and the rate is comparable to its insurance on a crop duster which operates on a much more hazardous mission. In addition, liability insurance is high as a passenger insurance.

- **High cost of personnel.** Helicopter pilots operating over urban areas must have a high degree of competency and qualifications. Subsequently, the highly skilled pilots and maintenance personnel required for safe operations can command high wages.

McNair, nevertheless, plans to continue Helibooks and expand his service ultimately to a fleet of 10 helicopters. The service at the midship point constructed in his low personnel design of new structures to include helipads in their plans. Two new buildings are being constructed in the Los Angeles Wilshire district will have helipads for helicopter landing pads. The efficiency of helicopters in avoiding downtown traffic is beginning to be utilized now by businesses such as banks and department stores to bring the day's receipts to a central location to facilitate billing and other financial functions.

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#### **Charter Operations**

McNair Helicopter Service, operating out of Van Nuys Airport, 10 mi. south of the city center, is one of the better known charter operations in the Los Angeles area. McNair numbers 36 charters including corporate executives, construction companies, oil companies, banks, department stores, federal, state and local government agencies, movie studios and fiscal matters.

The clients have contracts with McNair which specify a maximum amount of flying time monthly and they are billed at a lower hourly rate than the one-time companies who are charged from \$180 to \$170 per hour, depending on the type helicopter.



#### **JetStar Joins Canadian Transport Fleet**

Lockheed Jetstar enters service in undergoing a shakedown period in Canada in a prelude to its being phased into the Canadian Department of Transport fleet. Aircraft will be used in evaluating operational needs only of high altitudes and setting performance parameters.

McNair so far has only one down town spot located atop the newly completed Signal Oil Co. building. An agreement exists with Signal giving McNair on-call rights to the landing area, an arrangement which was effected because Signal was McNair's client before the building was erected. This means McNair will be available to McNair in the Wilshire district following the completion of two month started office buildings. McNair will not use these sites exclusively but will share them partly with other operators.

McNair was founded in October, 1955, by James W. Gaven. The company went through a period of barnstorming much like that which occurred in the early days of aviation. Strains such as the delivery by helicopter of Santa Claus at a local television show were standard fare. Gaven used his own business as a basis for his company but eventually it grew into a large range business outlook. Gaven says he became increasingly worried about operating helicopters in places like the apartment parking lots when groups of children would be likely to crowd close to the aircraft. One accident resulting from the type of open area might have ruined the company, financially, in addition to creating severe publicity for the helicopter industry. McNair gave up and retreated to return his charter work to the extent of barnstorming.

One of McNair's helicopters, a single-engine Bell 47-G, is operating in New Mexico under contract to Northrup's Radianco Division. Under a contract guaranteeing 60 hr. per month, the Mexican Bell was employed to return Radianco's drones over target

practice on the Army's White Sands range. The drone retrieval program turned out well and the helicopter has been employed on other missions such as supplying personnel located in high mountainous areas where surface transportation is very difficult.

McNair picture companies in providing some work for McNair in the success of one film operation seems to generate more ideas for the use of helicopters. A typical charter will be for McNair to take the part of a Russian helicopter in a forthcoming movie. This will accurately portraying the helicopter a dual goes into maintaining a role over the landing.

Not only will the helicopter be used as a prop in the movie but will be used as a platform for photographing aerial sequences.

McNair picture photography from helicopters formerly was not too common but the development of new blades which reduce low frequency, high amplitude vibrations makes aerial photography much more practical.

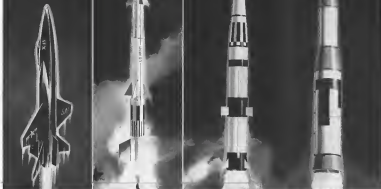
#### **Approach Techniques**

McNair's chief pilot, Peter K. Fawcett, with whom this Aviation Week reporter rode first atop the Signal Oil building to McNair's Tower headquarters, discussed the methods of such top operations and some of the hazards inherent in it. Two types of approaches are used in today's landing, although there seems to be no variation in take-off techniques.

- **Slow, easy approach** using considerable power.
- **Fast approach** made with considerably less power.

Each of the above methods has its

## PROGRESS IS A HABIT



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### Repeatedly successful in flight...giant strides in

With frequency and regularity bordering on the monotonous, propulsion systems from Thiokol powering these major U.S. missiles have been meeting objectives in flight tests. Current and past. ■ Since March of 1959, the XLR-99—most powerful man-rated rocket engine in the world—has been carrying man to heights and speeds never before attained by manned aircraft. Each excursion into the near reaches of space has added another notch to the

program of manned flight, and knowledge for future application. Its latest triumph, exceeding the 4000 mph design ■ Hardened into space by the most powerful solid rocket engine of known flight record—450,000 lbs thrust—Nike-Zeus shows rapidly increasing promise as America's anti-missile missile. The first stage propulsion system was developed and is built by Thiokol who is now also producing the new high energy Zeos second and third stage.

# Thiokol

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### the race for space

Thiokol's production maturity has given the military highly reliable Pershing and Minuteman—its budgeting low cost. Minuteman boasts the largest single solid rocket motor ever flown. Recent performance marks Pershing as the Army's most significant solid-fueled artillery weapon.

FIRST IN  
ROCKET PROPULSION



### French Design Turboprop-Powered Lightplane

Currently in production, the first order Airbush (just what a concept), is being built by SIPA, a joint French-Italian consortium. SIPA's ST1 Airbush is powered by a single Turbomeca Armois 1B 160-hp turboprop. Aircraft will have a cruising speed of 205 kt and a range of 1,020 mi. First flight of the aircraft is scheduled for this spring.

advantages but both of them require considerable technique. The first, favored by Pirelli, provides the advantage of putting the wind currents which may behave wildly in the vicinity of tall buildings. With this method, there is only a brief moment when it is particularly hazardous whether or not the machine will lead on the road or in the street of the region for an unobstructed line. Should it fail before reaching the road, sufficient obstacle usually will be available to effect some safe turn into the road before ground contact.

The first approach is adopted by some pilots because it can be made strictly non-stop in the event of an emergency. It has the disadvantage of not allowing the pilot to feel out the prevailing wind currents in the landing area. Conflicts between proponents of the two methods remain unresolved since it is largely a matter of individual preference. Most favor the latter in the opinion that an engine failure might occur at any time, the wing section of the helicopter to strike the side of the building or only a portion of the landing pad, although such an accident has not occurred in Los Angeles.

A public service, possible only through one of the helicopters, is provided in a local radio station here which provides traffic reports to motorists during peak traffic hours. Operating under the name of Airwatch, the helicopter takes to the air each morning from 5:30 to 9 a.m. and again from 4:30 to 6 p.m. On days when traffic is heaviest, Mountain, morning and Friday morning, Airwatch uses two helicopters to report freeway conditions and other surface traffic. Helicopters carry the normal VHF radio gear with which they communicate with control towers and Army Traffic Control.

Airwatch flies its two Bell 430 to 350 ft, set north and south, at a height of 157 ft (usually) included in the total is a small amount of ground level along which is devoted to transmitting radio, television and motion picture transmissions. Changes for the flying time average out to about 40 seconds in an average 10 to 150 ft per hour. The cost does not, however, reflect a profit factor because the radio stations and Airwatch are jointly owned.





# 5 New propeller development to answer key VTOL problems

**1. The variable-number propeller,** now under development for the Navy, combines capabilities of both a high- and low-lift airfoil to meet high takeoff thrust requirements without sacrificing cruise efficiency. By differentially changing the angle of paired blades mounted on a common hub, the variable-number propeller provides an ideal solution to a classic problem of VTOL flight: the need for high takeoff lift and efficient cruise capability of the propeller system.

Present studies show the variable-number propeller could make possible a number of major performance increases for varied types of future aircraft.



**FOR TAKE OFF AND LANDING:** blade angles are adjusted differentially so that each pair of blades simulates a high-number surface for maximum thrust.

**FOR CRUISE:** the paired blades automatically position to act as a low-number surface for maximum efficiency.

**2. An advanced redundant control system,** with self-contained, separate hydraulic systems, components, and stand-by master controls, is also under development. This system will provide a whole new level of reliability and sensitivity through critical VTOL operations—lift-off, landing, and transition to forward flight.



**CONTROL LEVER DISPLACEMENT SENSITIVITY COMPARISON OF VTOL and conventional propeller controls.**

**3. Shrouded propeller versions** of the variable-number and conventional blade propellers are presently in advanced stages of study at Hamilton Standard. For VTOL and other aircraft applications, shrouded propellers with 30% smaller blade diameters will deliver performance equivalent to free propellers with conventional size blades. Resulting size and weight savings meet VTOL requirements for compact system configurations.



**SHROUDED PROPPELLER,** as part of the latest Hamilton Standard test program, undergoes high-speed wind tunnel tests.

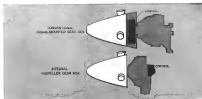


**PULL-SCALE** lightweight blades receive extensive fatigue tests at Hamilton Standard.

**4. New Lightweight Blades,** under development for the variable-number and conventional propellers, consist of a primary load-carrying steel spar and a fiberglass shell. The proven tubular steel spar design approach permits a high strength-to-weight ratio; while the fiberglass cover provides a

minimum weight airfoil, easily tailored to any specified blade planform.

In VTOL applications, for example, this blade design will reduce propeller weight by as much as 25%, and will permit a significant decrease in overall aircraft weight with correspondingly improved performance.



**INTERNAL GEAR BOX** propeller installation eliminates duplicate housings and other components, achieves a 15-20% reduction in the combined propeller and gear box weight. Permits considerably more compact configurations for VTOL aircraft.

**5. A weight-saving integral gear box,** which combines engine reduction gearing and main propeller controls within the propeller assembly, is also being developed under Navy con-

trol. This integral gearbox will simplify gearing in any propeller application and provide important weight savings in VTOL and other advanced aircraft designs.

Answering key problems of VTOL and other advanced aircraft is the object of a comprehensive development program at Hamilton Standard

today. This work is a natural outgrowth of more than forty years of designing and producing propellers for the aircraft industry.

**Hamilton Standard** DIVISION OF UNITED AIRCRAFT CORPORATION

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**U  
A**



## JPL Simulator Testing Full-Scale Mariner Model

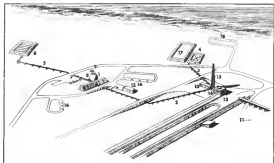


Pendora, Calif.—Tests on a thermal model of the Mariner Venus probe in a newly completed space environment simulation at California Institute of Technology's Jet Propulsion Laboratory were begun recently by Consolidated Vacuum Corp.

For their work, the full-scale Mariner model, measuring 10 ft. high x 34.5 ft. across, is site partly will be subjected to the rigors of an environment just that of outer space. Pressure within the simulated 47 ft. x 34 ft. diameter chamber will be held to  $10^{-6}$  millimeters of mercury or about one-millionth of an atmosphere. At the same time, the Mariner will be subjected to heat equivalent to that of the sun projected by 131 on ordinary sunken tanks of 3.5 kilowatts each. To preclude absorption of heat by the walls of the chamber, work would normally be isolated back to the test just yet, the walls of the chamber will be cooled to a temperature of  $-101^{\circ}\text{F}$  so that heating conditions simulated with those found in outer space will be reproduced.

Solar problems will be simulated by directing the radiation from the sunken tanks, each backed by a 35-in. reflector, into into a parabolic mirror three into a hyperbolic mirror. From there the light is reflected into the chamber through a lens. The beam, which is 1 ft. in diameter, is widened to 12 ft. by reflecting it onto a 2.5 ft. diameter mirror then to a parabolic mirror at the top of the chamber. The parabolic mirror focuses the beam which radiantly reproduces the radiation of the sun.

## SPACE TECHNOLOGY



**LIQUID HYDROGEN** storage and transfer system developed by Air Products and Chemicals, Inc., is shown in drawing of Cape Canaveral's Saturn Complex (77). Special tank (1) is used to store liquid hydrogen shipped from West Palm Beach. Other features of the complex are: liquid hydrogen transfer line (2), launch area vent line (3), launch area vent pit (4), storage area vent line (5), storage area vent pit (6), liquid hydrogen fill manifold (7), pressurization and (8) electric equipment house (9), advanced ground control station (10), launch house (11), RF 1 storage area (12), service tower area (13), launch pad (14), umbilical tower (15), service position (16), and shore pit (17).

## Saturn Liquid Hydrogen Facility Readied

Liquid hydrogen storage and transfer system (developed by Air Products and Chemicals, Inc.) is being fabricated and tested by Air Products and Chemicals, Inc., and will be installed this summer at Cape Canaveral's Saturn Complex (77).

The system, developed under a \$1.7 million National Aeronautics and Space Administration contract, will be used first with the S-4 stage on the Saturn C-1 and is expected to be applicable to the S-2 and S-4B stages on advanced Saturn vehicles.

Air Products currently is testing various components at its main plant in Allentown, Pa., and the Air Force's liquid hydrogen production facility, operated by the company at West Palm Beach, Fla. Following two-year of the system to NASA that summer, the space agency will conduct further tests using liquid hydrogen.

While the system becomes operational, probably late this year or in early 1965, liquid hydrogen will be shipped by tanker trucks from West Palm Beach to the launch complex and stored there under pressure in a spherical, 125,000-gal tank. Special insulation will be pro-

vided throughout storage and transfer to maintain hydrogen at its liquid temperature of  $-423^{\circ}\text{F}$ .

Transfer of liquid hydrogen to the launch vehicle will be accomplished at two flow rates—a fast rate to fill about 90% of the fuel tanks and a rate approximately one tenth as fast to "top off" the upper 10% to exact capacity. A vacuum jacketed transfer line with an inner tube constructed of a nickel-stainless steel will be used in the fueling operation. The alloy has a low expansion coefficient to reduce the number of bellows required in the line, the company says.

### High Vacuum

Air Products will completely evacuate the line sections to establish a high vacuum prior to vacuum insulation at Cape Canaveral. Field installation is to be completed, requiring only the welding together of line sections. A static vacuum with a two-year minimum life span is specified.

Liquid hydrogen sub-cooler will be incorporated in the transfer line to assure constant hydrogen temperature during the fueling. A specially-designed

vacuum pump will be used in conjunction with the sub-cooler to generate a temperature difference between the hydrogen fuel and the coolant fluid, also liquid hydrogen.

Venting systems are to be integrated with the Saturn vehicle's flow and automatic sequencing requirements. If draining and disposal of hydrogen are necessary, the vents are designed to bleed off large quantities of gaseous or liquid hydrogen. Controlled combustion test of hydrogen drained through the vent system will be accomplished at a safe distance from the launch area.

Automation is the overall system is designed for simplicity and ease of maintenance. Operating sequence of automatic and semi-automatic equipment has been built into the system, to permit operation from a site removed from the launch facilities.

The liquid hydrogen fueling operation is divided into four major phases, according to an Air Products official.

• **Cooldown** of the transfer line. Nitrogen or helium atmosphere will vent in the line before cooldown is initiated. Since all gases except helium freeze out at the temperature of liquid hydrogen,

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\*with both low cost and low maintenance



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### Second 100-in.-dia. Solid Rocket Fired

Second firing at Sacramento of an Aerojet/General 100-in.-dia. solid propellant motor in a 50 ft long configuration of three motor segments. The two end segments contained a mixture thrust of approximately 400,000 lb. and average thrust of about 500,000 lb. Duration of firing was 97 sec. See cover and p. 11.

liquids will be used to replace the nitrogen in the system before the admission of liquid hydrogen.

- **Motor fill.** The engine tanks will be pre-filled at the last flow rate, with the top off rate beginning near the end of the flow. Tanks will be filled to capacity, and an automatic valve closure sequence will end off the hydrogen flow.

- **Line purging.** An inert gas will be introduced into the line after a successful launch to vent any surplus hydrogen and maintain the transfer system in an inert atmosphere until the next loading operation.

- **Recovery of liquid hydrogen** from the transfer line in the storage tank. The line slope will drain the liquid toward the tank, and helium gas run be admitted to the line to speed up flow.

### Meteor Impacts On Moon Being Studied

Meteor strikes on the moon's surface and the possible meteoroid design experiments to anticipate landing on the lunar surface are being studied by Northrup/Boeing Corp. during a 10 day period next month.

The computer-aided study, now directed by Martin's Space Station Division, employs an optical transparent telescope with a 12.5 in. lens located northwest of Baltimore, Md. Magnification points at 60X and study periods correspond to the moon's third quarter through the new moon in the last quarter, when the earth reflects sun in a shade between sun and moon. An area approximately one-eighth of the lunar surface has been selected for remote watching.

Images of meteor strikes are picked off the telescope by a photomultiplier which amplifies the signal and passes it to a video tape recorder. The data stored in the strikes are being correlated with the signal broadcast by the National Bureau of Standards over station WWV. Interests of these are also recorded.

Observations began last December and based on limited experience so far. Meteor scientists believe that an average of 10 to 12 meteor strikes the lunar surface at velocities of about 34,000 mph.

Threshold size of the meteor is selected by the system as that of a child's marble or larger.

Meteor scientists hope to know by next year whether this technique is valid. For determination of the frequency, size and time of meteor strikes hitting the lunar surface. If this pilot study does prove to be successful, the experiment can be expanded with a second telescope and more sensitive sensitive photographic equipment.



**Answer:** The system designed Bendix® HYDRAULIC MOTOR is a positive displacement unit with a cartridge design capable of providing constant low intermittent load working, in stalled service. Pressure sensitive relief plus support by a hydrodynamic bearing results in low friction operation over the entire motor speed range. The motor is suitable for servo or non servo operation. For servo motor operation, the servo valve is required.

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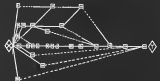
Design characteristics serve motor, adaptable and thereby insures the maximum flow volume which results in a high hydraulic stiffness and excellent motion response. Servo flow 0.7 to 0.962 cu. in. per stroke. Speeds to 3600 rpm. Bendix design assistance includes advanced hydraulic systems for missiles, aircraft, industrial valves and cranes. Use. Let Bendix help you with your systems requirements. Write: Manager, Fluid Power Equipment Sales, Bendix Products, An Aeroquip Division, South Bend, IN 46601.



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A critical path program chart

General Dynamics|Electronics' versatile S-C 4020 Computer Recorder draws complete critical path schedule charts in less than a second. It is the fastest, most economical method available today to translate digital computer language into usable graphs, tabular data, or drawings. Information is recorded on 35mm microfilm which can be enlarged to wall size viewing charts, or directly on page size photorecording paper. Write today to Department C-30, General Dynamics|Electronics, Post Office Box 2449, San Diego, California. **GENERAL DYNAMICS | ELECTRONICS**

Typical critical path scheduling chart on the left of the SC4020. CHARACTERISTICS SHEET FROM THE LEFT OF THE SC4020.

**GENERAL DYNAMICS | ELECTRONICS**  **SAN DIEGO**

## PRODUCTION BRIEFING

Hawthorne Standard Division of United Aircraft Corp. will provide propulsion for Military Air Transport Service Lockheed C-119E tailpropeller transport under a \$50-million contract from Navy Bureau of Ships.

Russco Engineering Co., Stamford, Conn., has received a \$1,402,000 contract from Lockheed Martin and Sperry Corp. to produce testbenches across the Atlantic space vehicles. Systems are internal devices which activate small jets to keep the vehicle in a programmed attitude relative to the earth.

Teleconsporing Corp.'s Advanced Structures Division, Los Angeles, Calif., has received a \$360,000 contract from Boeing Co. to provide critical flight testing for the 737 jet transport.

Workinghouse Electric Corp. will continue design and development of a reactor for use in the Navy nuclear rocket engine under a follow-on contract from Aerojet-General Corp., Azusa, Calif. contract. Contract covers covering the most space nuclear work on the project totals \$5.5 million.

Electro-Optical Systems, Inc., Pasadena, Calif., has received contracts totaling \$154,215 from National Aeronautics and Space Administration for additional research and development of electric propulsion engines.

North American Aviation, Inc., has received a \$7.1-million Navy Bureau of Weapons contract for modification, testing, demonstration and evaluation of the F-111 jet trainer with dual engine installation.

Bochel Corp., Vero, Calif., will perform architectural and design engineering for three construction projects at Naval Air Station and Space Administration's Vandenberg Space Light Center, Hesperia, Ala. The projects, estimated to cost about \$2 million, include expansion of the test device facilities, two 10,000-gal liquid oxygen storage tanks and partial construction of a liquid hydrogen test facility.

General Dynamics|Electronics will supply modification kits to add to its single recording to TACAN systems and include about 100 new tactical aircraft. Contract exceeding \$2 million from BuWeps calls for modification kits which will enable pilots to determine distance separating each other as well as distance and direction between the aircraft and TACAN ground stations.



*The Lincoln Laboratory program for ballistic missile range measurements and penetration research includes:*

### EXPERIMENTAL RESEARCH

Measurements and analysis of ICBM flight phenomena for discrimination and for design purposes, including optical, aerodynamic and RF effects.

### SYSTEM ANALYSIS

Studies to apply research findings to advance the technology of ICBM and ACBM systems.

### INSTRUMENTATION ENGINEERING

Designing radar, optical and telemetry equipment with which to measure ICBM flight effects under actual range conditions.

### RADAR SYSTEMS RESEARCH

Extending the theory and application of radar techniques to problems of discrimination, countermeasures and performance in a dense target environment.

### HYPERSONIC AERODYNAMICS

Study of the flowfields around reentering bodies for various body designs and flight conditions. Excellent computer facilities available.

### RADAR PHYSICS

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- A more complete description of the Laboratory's work will be sent to you upon request.

All quoted contracts will involve modification for equipment without regard to new, used, or in industrial stock.



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## USAF Studies U.S., Soviet Space Potential

(The Force Lt. Gen. James Ferguson, deputy chief of staff for research and technology, told the House Armed Services Committee recently that it will take a concerted national effort to create a military posture adequate to counter the potential threat of the Soviet Union's military activities in space. In a public statement released after the closed hearing, Gen. Ferguson declared the Soviet threat and outlined the Air Force Space Plan (AOP) Feb. 26, 1975, a study of the state of space technology in the Air Force today and of its long-range objectives. Ferguson's remarks are published in capsule excerpts from the statement because of their importance to the aerospace industry.)

The basic military strategy of the free world has been founded in superior rates on technological superiority in all combat areas. Realization of our technological superiority is challenged by the Soviet space efforts and recognized accomplishments of the Soviets. It may be extremely difficult, if not impossible, for meaningful defense actions to counter some of the possible military applications of the Soviet advances in space technology.

There are, in effect, three major military problems confronting us today. First, there is a marked imbalance between the Soviet bloc and the free world relating to intelligence activities.

Second, our defense against Soviet ballistic missiles is inadequate, as this country demonstrates fully. Third, the Soviets have demonstrated increasing competence in space technology which may have application to a broad spectrum of military systems. Since we cannot know the Soviet's intentions, we must be prepared to respond to a variety of threats—and to react without delay when the need is clearly defined.

Potential solutions to each of these three problems are offered by space systems, techniques, and applications. I stress the word, "potential." Much basic and applied research remains to be done strictly to ascertain that solutions are technically feasible. Thus, advanced development will be required to demonstrate substitutes or restore capability and economic feasibility. It thus the decision to make progress for research, prediction, operational development of the full system will be undertaken.

We have completed our initial study of this potential Soviet threat, the status of our technology relative to space applications, and the long-range objectives and needs of the Air Force. These long-range objectives and needs have been derived from a national viewpoint. We have considered them in relation to programs of other agencies, particularly the National Aeronautics

and Space Administration. This has permitted us to prepare a coordinated, well-balanced plan for the future which outlines the best use of our limited resources. We have prepared and published a document, called the Air Force Space Plan, which summarizes our current views on these subjects and identifies specific technological objectives for the next 10 years. Under a cover letter from the Chief of Staff, the Space Plan provides our guidance to the whole of the Air Force research and development community. Most of what I will have to say is based on the Space Plan.

I shall discuss in succession three topics: the philosophy underlying our interest in space capabilities, the military tasks to be performed in space, the technological problems we foresee

and the research and development programs we must initiate to meet the current status of our accomplishments in the past, present and future, our conclusions.

The U.S. national space policy recognizes four reasons for conducting projects in space: to increase scientific knowledge, to exploit commercial opportunities, to strengthen military capabilities, and to enhance national prestige.

The prime objective of the Air Force space policy is to exploit space in order to retain U.S. military superiority in order to insure the peaceful use of space. To accomplish this, it is necessary to regain the lead in military space technology.

It is clearly recognized, however, that space systems must be considered in context with all other weapon systems. Space systems will be selected for development and use which offer either the only means or the best means of performing a specific mission. Space systems and related advances in technology will be further explored for their prestige and scientific value.

### Development Patterns

In future extending and existing space flight technology, the Air Force will be continuing the pattern of development which has led to a single system from Kollsman's Mark 100 to the Wright Brothers first powered airplane and on to Mach 1 aircraft but also through the first air-breathing engine installed in the Mustang and environmental habitable inside. This logical progression has already led to manned satellites which are now scheduled for certain military missions. It has led from the X-15 experimental rocket aircraft through the X-15 and is leading now to the Dyna-Soar. It will lead beyond, to manned space stations and possibly to advanced space-based missile capability and sustained flight to and from space. All of these advanced capabilities have potential implications to control military missions. The Air Force will play the major military role in developing these capabilities.

The Secretary of Defense by directive of 6 March 1961 has assigned to the Department of the Air Force the responsibility for research development, test, and evaluation of Department of Defense space development programs and projects which are approved after the date of the directive. This same directive authorizes each military department and Department of Defense agency to conduct space research, research to develop new ways of using space technology in order to perform its as-



LT. GEN. JAMES FERGUSON

Lt. Gen. James Ferguson, deputy chief of staff, research and technology, U.S. Air Force, was born in Tacoma, Tennes. Aug. 16, 1913. He began service in the United States Air Force in 1935. He was promoted to Major General in 1961 and is now a Lieutenant General in the Air Force.

In 1954 he entered the Air Corps, completed flight training and became a second lieutenant in 1955. Gen. Ferguson served in Europe during World War II, in Turkey after the war and in Korea.

He was named deputy Commander of Tactical Air Command's Ninth Air Force in 1967. He became Vice Commander, Air Research and Development Command in 1969 and last April became Vice Commander, Air Force Systems Command.

Gen. Ferguson was assigned as deputy chief of staff, research and technology, Headquarters USAF, and promoted to lieutenant general last December.



Bad weather costs big money. When engine and visibility fall below minimums, jet operators in particular face big losses, because of schedule disruptions, idle equipment, passenger and cargo diversions. Lower takeoffs and landing minimums are the answer, provided these can be achieved both safely and economically. They can, because Sperry has been at work for years on every aspect of the problem.

Sperry has made hundreds of fully automatic landings in test, safely proving both concepts and equipment. First prototype of the ultra-reliable automatic pilot of the future—the Sperry

SP-50 with built-in glide slope extension capability for upcoming Boeing 727 jet-liners—already have been delivered. The famed SP-50 system, in service aboard the Douglas DC-4, Cessna 310 and 590, was designed with the maximum landing needs of the future in view. Douglas and Sperry already have demonstrated automatic takeoffs and landing approaches to the point of flare in the DC-4, employing SP-50 with glide slope extension and other refinements.

Among new Sperry flight instruments, concept is a system which will automatically display runway approach lights on the pilot's windshield, in any weather,

Other "look-ahead" windshield displays are in flight too. Electronic monitoring and pilot warning systems, autopilot and sensor computers are in being today, and under continuing development.

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inged functions. Upon completion of such performance research and upon DOD appraisal of subsequent development efforts, the Air Force would normally be assigned developmental responsibility. I can assure you that the Air Force intends to be fully responsive to the needs of other services and DOD agencies.

The timely and economical development of the nation's space capabilities will require the closest cooperation among all participants. A true spirit of arrangement must exist between the Air Force and NASA if full advantage is to be taken of the technical accomplishments of each agency. The Air Force and NASA have already established the broad basis for cooperation and a concerted effort is now being made to establish the principles and to formulate arrangements in connection with the future program which will permit the fullest cooperation at all levels of Air Force and NASA management.

At the technical level, we are in agreement with NASA officials that our programs need be mutually supporting—rather than competitive.

Accordingly, the 10 major NASA Air Force management agreements which have been consummated since 1959 will be followed by such additional agreements as may be required by the expanded NASA program. Such that Air Force Research and Development efforts are now assigned to share with NASA. These data already the extent to which NASA and Air Force efforts are already integrated within the National Space Program.

#### Planning Needs

It is important to note, however, that some operational and technical requirements are not common to both the civilian and military effort. Later in my discussion of the Air Force's pressing technological needs I will point up a number of these differences. In closely integrating our program with NASA in furtherance of its goals while at the same time maintaining adequate air research on purely military needs, the Air Force will utilize its best contribution both to the national effort and to the nation's future military space capabilities.

The Air Force has devoted considerable study to determining the military potential of proposed space systems.

A number of early military applications are feasible during the next few to seven years. These will include space warning offering potentials better than those otherwise attainable for guidance, warning, warning of ballistics missile attack, early surface navigation and our technological superiority. Communications satellites promise a better status of global military communications. Be-

cause these early applications space is expected to offer more possibilities than of these early applications will undoubtedly result in more difficult progress is achieved in space technology and operations. Most of the future applications which can be anticipated can await further technological progress before being defined in detail. Therefore, these applications are not discarded now in favor of the military tasks they may perform.

#### Warning Systems

These future applications will certainly include proposed space systems for attack warning and for nuclear test detection. These systems will also be effective in providing early warning of entry of a potential aggressor. Further, it should be possible to obtain space systems which will considerably extend early powered-based capabilities for surveillance of uncooperative satellites.

Space systems also provide a breakthrough in the area of defense against ballistic missile attack. This was one viable technique for early interception of hostile missiles. Moreover, this earlier concept would provide additional security through defense in depth and tactical flexibility, against other types of space weapon systems.

Should the development of early based systems become marginal, developing systems in deep space may be the only means of providing defense and remote location to create an early warning. For example, space-based command and control systems may offer a significant means to survivability. Further, detection of communications between earth and space may support space-based command and control systems for control of space operations as an extension of our present command and control units.

Meteorological surveillance, navigation aids and research and development testing will continue to be important support tasks having no space alternatives. Other principal support tasks that are expected to evolve are logistics including weapon maintenance and repair, intelligence gathering, training, and routine.

Military space technology has at its broad foundation many fundamental technological areas. In general, capabilities in these areas will be required for other civilian as well as military space programs. However, the exclusion of military needs will frequently demand special or unique characteristics in one or several of these capabilities. Such factors as cost, dependability, reliability, quick reaction, positive control, security, and the quality consciousness have different implications for military communications, or postage applications. For example, readiness in a battle

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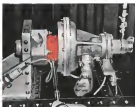
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Temperature Resistance	-100 to +300 °F	-100 to +300 °F	-100 to +300 °F	-100 to +300 °F	-100 to +300 °F	-100 to +300 °F
Specific Gravity	1.10	1.10	1.10	1.10	1.10	1.10
Modulus at Break	100-1,000 psi	100-1,000 psi	100-1,000 psi	100-1,000 psi	100-1,000 psi	100-1,000 psi
Breaker Strength, psi	500	400	300	200	100	50
Elongation, %	10	20	30	40	50	60
Resilience, %	10	20	30	40	50	60
Volume Shrinkage, %	10	20	30	40	50	60
Set at 100°C	100	100	100	100	100	100
Elongation, %	100	100	100	100	100	100

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concernment with noncooperative, no-ave targets will be a further requirement. In contrast, the laser landing program will require satellites with cooperative targets to specified and controlled orbits. As such, accuracy of such operations as these, and a growing understanding of the potential military implications of space laser technology in shaping the Air Force space program. As a result, we have undertaken a series of closely related efforts. These efforts have been carried out both to explore the military applications and, at the same time, to expand our capabilities in several well-defined areas of technology. It will now discuss these 11 areas with you and will outline briefly the major programs which are under way and some which we can discuss in detail during the next few years.

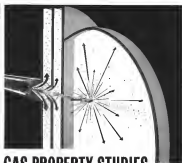
## Improved Boosters

To begin with, all space payloads require launch vehicles to get them into space. While launch vehicles, reliability, and cost reduction are desirable for all space activities, they are especially critical for military applications and to become practical. Consequently, we are pursuing two concurrent courses. First, we are working toward increasing the thrust of chemical boosters for the earlier military missions in space. Secondly, we are bringing forward the technology of nuclear rockets in anticipation of benefiting from their great potential for longer endurance, more favorable thrust-to-weight ratios, and reduced cost per pound thrust in orbit. In the chemical area, nuclear powered rockets will result from modifications to the Titan 3 booster. Such modifications as the addition of solid storable rockets, for example, could result in the capability for placing several tons in orbit. The large solid booster program will provide the basic technology for development of future solid rockets capable of placing even larger payloads in orbit. The Atomic Energy Commission and NASA are currently carrying the present efforts in nuclear rocket technology.

Within our present funding source from the government, we are also at work on various other programs, such as the development of a new generation of launch vehicles.

## In-Space Propulsion

If the payload is to maneuver in space, subject payloads ranging from few thousand to high thousand pounds, is required. Although low-thrust propulsion is essential to maintain all satellites in space, such requirements as maneuvering in orbit, or moving objects electrically in orbit for a high degree of maneuverability are essential to versatile operations. Continued effort in applied research upon low-



## GAS PROPERTY STUDIES BY MOLECULAR BEAM

Depicted above is a refined surface hypersonic shock tunnel used as a source of high speed neutral atoms and molecules for a "molecular" beam. With this beam, the constraints of air are made to collide at the atomic kinetic energies appropriate to the high temperatures encountered in hypersonic flight. Too hot to be produced by an oven, per se, air can now be obtained continuously from an ion beam by charge exchange. These particle energies can readily be observed from a shock tunnel. In the experiments, kinetic energy is contained in a well-defined surface molecular motion. When scattered from a gaseous target, this beam will allow differential cross sections to be measured and provide such needed data on which to base better calculations of gas properties. When scattered from a solid surface, the beam can provide information about the pathways of energy between the beam and the surface as well as information about the structure and chemical characteristics of the surface.

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## U.S. Air Force Sets Four World Climb Records With Its T-38 Trainer

On February 19 the U.S. Air Force announced that its own supersonic T-38 trainer broke four time-to-climb records previously held by one of the highest performance fighter aircraft. Taking off from a standing start, the T-38 reached:

9,843 feet (3,000 meters) in 33.624 seconds  
19,686 feet (6,000 meters) in 51.429 seconds  
29,529 feet (9,000 meters) in 64.76 seconds  
39,372 feet (12,000 meters) in 85.74 seconds

These world records were set by Major Walter Dunsen in a Northrop T-38 at Edwards Air Force Base, California.

His time to 29,529 feet was 10 seconds (or 20 per cent) faster than the previous record.

The young man who enters the U.S. Air Force today can look forward to beginning their supersonic flying program in a trainer matched to the performance of the most advanced tactical aircraft. Next month the Air Training Command will graduate the first class of pilots to receive their training in the record-breaking T-38.

# NORTHROP

first electrical propulsion is expected to calculate this year as the first test of an ion engine in space.

Further testing of electrical propulsion units will be conducted in a series of coordinated Air Force, NASA, and AEC tests under a program involving nuclear power supplies. The higher thrust requirements for rapid and sustained maneuvering in space can be met neither by chemical rockets using strong propellants. We have presently under consideration several charts which have been under review in the applied research program. These can identify and show the necessity for undertaking an advanced technology program on a chemical upper stage for its quiet maneuvering.

The most promising approach for later maneuvering capability, however, undoubtedly is represented by the nuclear rocket.

I have been speaking thus far of problems in space, whether manned or unmanned. Obviously, if the payload includes man, bioastronautics equipment is necessary to ensure life and to permit man to function effectively. How effectively, we know not for sure. Consequently, the growing question of special military interest is "Can man effectively perform specific military tasks and use combat functions in space?" The Mexican program will provide some early data at the lower orbital altitudes. However, to answer the question for larger distances means and for operations through the Van Allen belts, we believe that a logical progression of experiments is necessary in order to proceed with dispatch and confidence. The Air Force has selected its own experiments, and integrated its usual capabilities in bioastronautics and has in fact been carrying on a vigorous applied research effort in this field as a adjunct to our extensive participation in the Mexican program. However, our investigations to date have been largely limited to ground based testing. We are currently studying and making plans for these advanced technology programs which would involve testing in space to determine man's military capabilities in space. These programs would of course, provide substantial contributions to the overall National Space Program.

The effects, use of man in space and the adequate design of the vehicle and payload demand detailed communications data on space. The needs for these data are common to all agencies concerned with the design of systems capable of performing dependable orbital operations. Because of this we in the Air Force are relying heavily upon the efforts of NASA to provide us with these basic scientific data. We are, however, carrying on applied research

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in these aspects of the environment which satisfies the design and operation of various images to military operations. As an example, the satellite acquisition for continuous operation makes especially critical the need for solar flare forecasting. We have developed crude techniques for this further research, we expect to supply earth support, this capabilities allow this decade.

If operation from a space vehicle or base other than the one used for transport is required, a capability for indication, tracking, and transfer is necessary. We believe, however, that the earliest military capabilities needed in this area of technology, is the need for reconnaissance satellites in order to inspect space. As we reported in our last year, we have undertaken the Satellite Inspector Program (SIP) to provide for an earth-based detection of increased resolution. Within the limitations of our available funds we have given this program the highest priority and the first reduction demonstration will be in early 1965 deployment. This, coupled with increased industrial is another military need. We expect, however, to depend upon the National Aeronautics and Space Administration Cosmos program for the initial step toward this technology.

### Power Supplies Required

As capabilities to operate equipment in space are advanced power supplies will be required. We in the military have a special interest in power supplies for long duration, high-power systems of several hundreds of kilowatts. As an example of this application, they will be required for future electrical propulsion units. Accordingly, we have under way the Space program which will result in the demonstration of a long-duration, high-power system by the latter part of this decade, based upon current funding. For the near-term applications, at most, modest power levels, we may undertake in the near future an advanced technology program for a smaller solar power supply. As a step toward higher powered nuclear supplies, a 30-kilowatt reactor power source will be tested in space within a few years.

One of our primary interests in space is surveillance. Observations from space for a variety of purposes require sensors. This area of technology has occupied a particularly significant position in our military program, as you are aware. Within this program, and in cooperation with the highly automated Director program we have been advancing sensor technology at a rapid pace. Much remains to be done, however, and the pursuit of improved infrared sensors, high-resolution photographic cameras, and improved radar represents a large

portion of our applied research program. Many of these projects are approaching fruition. We are expanding our efforts and have with respect to their color also in space through a series of related advanced technology programs.

The Space Detection and Tracking System, Spadon, which is partially operational now, will detect small target space objects and will provide the acquired data directly to North American Air Defense Command and Defense Canada.

### Communications Technology

Communications from space to earth, to other points in space, or between points on earth via space, require communications equipment which will function not only in space but will also be used in the atmosphere. Communications technology areas from the need for an integrated secure, reliable air communications which will reliably operate under any anticipated conditions including the presence of interference—man-made or natural. At the present time, Air Force communications efforts are confined to the applied research program to project West I and we recently attempted unsuccessfully to disperse small dipole infection in orbit to serve as a passive, non-emitting air communications system. We expect to repeat this experiment soon. Beyond

this our efforts are applied to the study of integrated systems to be realized in defining certain activity, which the communications requirements of interest to the Air Force.

### Security and Recovery

The return of payloads from space requires security and recovery. To be of continuing military value, satellite space operations must be capable of reliable performance. Characteristics of electronic, mechanical, flexibility, and availability, probably long-term operational employment of our interest is then designed for one time or infrequent recoverable experiments. We believe that the return from space is a specific need for technology, a growing industry, conventional scientific leadership within the largest possible geographical area and with subsequent use of the vehicle after mission termination. In addition, the possible future requirements for military systems give a potential need not shared by nonmilitary agencies, for precision recovery. We are, in our applied research and advanced technology program, pursuing projects relating to these operationally advanced aerospace propulsion concepts, advanced guidance and control systems, and other. The Director program has been instrumental in providing us several orbital region and in events and

### PROBLEMATICAL RECREATIONS 108



Two motorcycles set out at the same time to go from A to B, a distance of 100 miles. Both followed the same route and traveled at different, though uniform, speeds of an integral number of miles per hour. The difference in their speeds was a prime number of miles per hour, and after they had been driving for two hours the slower car was five times further from A than the faster car was from B. How fast did the two motorcycles drive? —Continued

Don't tell us, we'll tell you! We've got a new problem for your interviews during the 108. Show this month. Send your solution and phone number now to Mr. Henry Lutz and let us do the rest. We'll tell you (using the experts!) and arrange a convenient date and time for you to meet with a member of our technical staff in New York.

ANSWER TO LAST WEEK'S PROBLEM: The area of the triangle will be minimal if the fourth tree touches the side on which it has. The area of the triangular portion is 993,220 square yards. The length of the fence is 3,918 yards.

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Years of pioneering in V/STOL aircraft has resulted in Ryan winning the competition to design and build the U.S. Army's VZ-11 high-speed jet V/STOL research aircraft to be powered by General Electric's lift fan propulsion system. If you are a career engineer interested in this very advanced concept, which may alter the entire future pattern of flight, you are invited to talk to Ryan concerning a top salaried job.

Stable, long established Ryan is on the move! A highly diversified company, Ryan not only has

two current VTOL programs but is also a leader in many other phases of space age aerodynamics and electronics.

You will find that Ryan Aerospace offers you not only a challenging opportunity now but also every chance to advance. And in warm, sunny San Diego on the blue Pacific, you will enjoy living that is considered America's finest.

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RYAN HAS DEVELOPED, tested & flown the VTOL aircraft now developed under U.S. Air Force contract



RYAN IS THE HEADQUARTERS of research VTOL aircraft designed, built and flown by Ryan for the U.S. Army and Navy.



THE SERVICE TILT WING VTOL program is being built by Ryan jointly with Chance-Vought and Sikorsky.

# RYAN AEROSPACE

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newer techniques which may have later application to future military systems.

In addition to these areas of tech- nology, there are major military needs in the areas of weapons and command-control equipment technology. In each of these two areas, we are presently sustaining our efforts to applied research. In the weapons area, we are investigating the feasibility of new weapons concepts. We are already aware that the most effective weapons of space may prove to be of a non-rocket variety. In this area, as in all areas, it is essential that we do not become tied to any one approach or subelement as the ultimate solution. In this same vein, we must not be restricted from exploration developments merely because a given application is not yet evident. The command-control function as the need for positive control outside the void the limited horizons of past years to the vast aspects of space surrounding the earth's surface, requires challenging problems.

We are limited at the present time to investigation of these problems in our applied research program.

### Man's Space Role

I have briefly touched on the major technological areas which underlie the new military exploitation of space. This concerns launch vehicles, in-space propulsion, communications, environmental data, rendezvous docking, and transfer, power supplies, systems, communications, recovery and recovery, weapons, and command-control. There is one further subject I would like to discuss at this point, however—man's role in space. Man has certain qualitative capabilities which machines cannot duplicate. He is unique in his ability to make the strategic decisions. He can discern what and select from alternatives which have not been investigated. He is adaptable to rapidly changing situations.

Thus, man's presence in military space systems will significantly increase the flexibility of the system, as well as increase the probability of mission success.

At an example, the early flights of the X-15 aircraft were confined to demonstrate the flight success rate on an unarmored base. Malfunctions occurring in several flights would have resulted in loss of the aircraft if it had been unarmored. Instead, all flights were completed successfully with the acceptance of use where possible landing through nose parachutes. It is for these reasons that we believe that man is essential not only in operational space systems, but also in these programs designed primarily to further technological capabilities in space. It appears that the Soviets have come to the same conclusion.

## Outstanding opportunities in: CONTROL SYSTEMS DEVELOPMENT

The Columbus Division of North American Aviation offers outstanding opportunities to engineers experienced in the analysis, development and design of control systems for missiles and aircraft.

Remotely operated systems are available for the following:

- Senior Engineer in Design**—to develop original designs of flight control systems using advanced adaptive and digital techniques. These systems include primary flight controls, secondary flight controls, actuators, control servos, distribution systems and complete autopilot systems. Complete analog computer facilities are available.
- Senior Engineer in Flight Aerodynamics**—to conduct stability and control, trajectory, and flight dynamics studies on advanced tactical missile systems. The study areas and closed-loop dynamic models include the effects of autopilot characteristics and system noise.
- Specialist in Aerodynamic Flight Qualities**—to conduct analytical studies of basic guidance, control system requirements and stability augmentation for conventional and V/STOL aircraft. We're responsible for formulating and developing static and dynamic criteria to evaluate stability and wind tunnel tests.

Please send resume to: North American Aviation, The Professional & Technical Employment Office, Attn: H. Keeney, Manager, 600 East Fifth Avenue, Box 44-01, Columbus 10, Ohio.

All qualified persons will receive consideration in employment without regard to race, creed, color, or national origin.

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Twenty Seven Management Selection Committees have been, in a completely unbiased and unbiased system to find the best qualified individuals in 60 companies which were...

In the year 1961 they spent over twenty-two hundred man-hours evaluating qualifications of employees. For every opening which arose these expenditures could be a thorough job of searching and they came up with one overriding concept, but it was that one was equal in qualifications, the leading company must have the best staff.

The most important and least makeup of these committees and a measure of the moral and ability of each employee and actively stimulate facilities to personal advancement within the Company.



## ENGINEERS, Have YOU Answered This Invitation Yet?

It appeared in the January issues of Scientific American, Aviation Week, Aerospace Engineering, Aerospace Management, Space Technology and a number of other publications. Answer indicated as to indicate that we already offer an increasingly high percentage of the advantages listed by the majority of Engineers AND THAT WE CAN PROMPTLY TAKE A PORTION TO FIT THE REQUIREMENTS OF THE INDUSTRY. We'll soon have here and you two doors and committees can be selected unless you challenge us to meet them by writing to WRAAT (WRAAT) (WRAAT).

We challenge YOU TO DO IT NOW!



THE ENGINEERING CENTER  
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chosen. Much of the Soviet space effort with which we are familiar is devoted to manned space developments.

More of the programs that we have under way now will soon require testing of vehicles and subsystems in the true space environment. We have studied these testing requirements, and we have concluded that a manned orbital test station in space provides the only reasonable solution to this problem of testing equipment designed for use in space. We are convinced that a manned, earth-orbiting station program should be undertaken as early as possible. We are looking toward a proposal that this be a coordinated program with NASA, possibly employing the Gemini vehicle as an orbital transport vehicle for use with the orbital test station. Through this coordinated program it seems reasonable to assume that the best interests of both the military and civilian test programs in space could be served.

## Significant Milestones

The December two day test was announced to imply that all our accomplishments are well to come. However, we have not been standing still. A number of significant milestones have already been achieved. Considerable progress has been made since the launch of Discoverer 1 in February, 1959. Among the accomplishments to which we look with pride are the 16 Discoverers launched in December, 1960, of which 15 have been launched into orbit and 11 have been successfully recovered from orbit. Just last December the capsule from Discoverer 16 was recovered after four days in orbit—which is a new record for time in orbit and recovery. The success in this program has increased our scientific knowledge and has strengthened our military capabilities. The probability of successful recovery and recovery of payloads from orbit is steadily increasing.

We have successfully orbited two Molay satellites this past year and we have required useful data.

## Dyna-Soar Program

The Dyna-Soar program, a cooperative effort with NASA, was conceived as a means to accelerate the early attainment of orbital flight to provide early technology for controlled re-entry and recovery needed for potential future military applications. The configuration for the Dyna-Soar orbital glider has been selected as preparation for its first orbital flight. An intensive analysis has been conducted on the Dyna-Soar program and we believe we have determined the best way to accelerate the schedule to achieve manned orbital flight in the Dyna-Soar at the earliest possible date. All key glider and associated contractors have been selected and

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Here is an opportunity to participate in a major expansion of a company which pioneered the space environmental field. Specific experience in space environmental controls is desirable but not necessary. Education requirements are B.S. and up. Garrett is an "equal opportunity" employer.

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that there are major residual external problems to which space systems offer potential solutions, that action of these solutions are available now that realization of additional future solutions is dependent upon advancing the state of modern space technologies, that the proposed 1955 Air Force Space Program is a significant next step to future space capabilities, and that the program in future years will need to be even more vigorous and comprehensive.

## Large Space Chamber Contract Awarded

Space environmental chamber with 200 ft. diameter will be studied for USAF under a research contract awarded by Aeronautics Engineering Development Center, Air Force Systems Command, to the Bechtel Corp.

Purpose of the contract is to study alternate structural and system configurations during a preliminary period. At the end of that time, USAF will evaluate the report to aid in establishing final design criteria.

Planning and construction of a smaller unit, the Mk. I Aerospace Environmental Chamber (AW-84, 25, 1951, p. 221), currently is under way at AEDC, with completion scheduled for the end of this year. The Mk. I chamber is 55 ft. in diameter and about 70 ft. high. It could easily fit inside the proposed new chamber, and be moved in whole upright through the airlock, which is about 70 ft. in diameter.

The new chamber will be used to check out complete spacecraft and system systems in vacuum and thermal conditions close to those of space. Provisions for occasional tests of nuclear-powered vehicles will be built into the chamber. Located, as prime contractor for the task, will lead a team including Chicago Bridge & Iron Co., Arthur D. Little, Inc., National Research Corp. and FMG Corp., McDonnell Aircraft Co. and Thermal Clerk Co. will serve as consultants.

## Vacuum Chamber to Test Saturn S-2 Components

Vacuum chamber which will permit thermal studies on simplified models up to 310 in. will be built at North American Aviation's Aerospace Laboratory and will be used immediately upon completion in late summer or early fall for stress and component testing for Saturn S-2 booster and Apollo spacecraft programs. The chamber, to cost approximately \$300,000, will be completely fabricated and will be used for space research on a corporate-wide basis.

It will be a horizontal stainless steel cylinder 15 ft. in dia. and 25 ft. long

ALBANY, N.Y. (UPI)—The Air Force announced today that it has awarded a \$1.5 million contract to the Bechtel Corp. to study the feasibility of building a large space chamber to test spacecraft components.

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**Manager Multiple Machine** experienced in all phases of machine operation and maintenance. **Field Service Engineer**

**Electrician**—Heavy and Machine Analysis experience and knowledge in all phases of electrical work and maintenance. **Field Service Engineer**—Heavy and Machine Analysis experience and knowledge in all phases of electrical work and maintenance. **Field Service Engineer**—Heavy and Machine Analysis experience and knowledge in all phases of electrical work and maintenance. **Field Service Engineer**—Heavy and Machine Analysis experience and knowledge in all phases of electrical work and maintenance.

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### RESEARCH

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### POSITIONS VACANT

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### SENIOR ENGINEER

**Senior Engineer**—Heavy and Machine Analysis experience and knowledge in all phases of electrical work and maintenance. **Field Service Engineer**—Heavy and Machine Analysis experience and knowledge in all phases of electrical work and maintenance.

## WHATEVER THE CHALLENGE ...

... whether it's manned spacecraft or further mastery of the atmosphere—engineers and scientists at Chance Vought take pride in solving new problems. Significant programs like Crusader, Scout, VTOL, Saturn and others have opened a wide range of opportunities. If you have a degree in engineering and 2 years' direct industry experience, investigate openings in these areas: ■ **TRAJECTORIES ANALYSIS** Vehicle performance analysis, trajectory analysis of rocket booster systems, familiarity with rocket engine performance characteristics and orbital and space flight mechanics. Assignment would be on booster vehicle systems; lunar and interplanetary missions and trajectory analysis, and development of advanced methods for

solving all types of trajectory problems. ■ **CONCEPTUAL AND PRODUCT DESIGN** Provide technical design input relative to the design of a major component of a spacecraft, launch vehicle, aircraft system or similar project. Specific assignment would be in the areas of conceptual design, major airframe structures, fluid and gas systems, electrical systems and components, and pneumatics and separation systems. ■ **AERODYNAMICS** Aircraft, missile or launch vehicle configuration design, stability and control, airloads and aerodynamic heating. ■ **ENVIRONMENTAL** Flight and vibration, acoustic and vibrational environments, control dynamics and fluid mechanics.



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### its leadership is confined to just

### the type of men you need, waste cir-

### culation is avoided.

## Physiological Hazards Of Space To Be Studied

Natural Aeronautics and Space Administration has given the University of California a grant of \$500,000 to develop techniques and instruments to measure changes in the body of an astronaut that may develop from long exposure to the space environment.

Responses of man-made machines will be studied in relation to effects of radiation, weightlessness and prolonged confinement. Recording instruments will be devised in such a way that the machines are unobtrusive inside space vehicles to measure changes in the physiological changes recorded as due to actual space conditions and not the results of physical restraints in the aircraft.

The grant will cover a four-year project and will be conducted by the University of California's Space Sciences Laboratory.

## Fission-Chemistry May Cut Chemical Costs

Production of economically producing new expensive chemicals by a process called atomic formation of fission-chlorides will be explained by Arnet-General Nucleonics, San Ramon, Calif., under a \$4-million, four-year Air Force contract.

The company already has converted quantities of ammonia into hydrogen by the process, which involves using a special atomic reactor in a chemical production plant.

Under the new contract, Arnet is building a large-scale fission-chlorine loop, designed to operate continuously in an atomic reactor, which is expected to be ready in 18 months.

The program is under direction of the Manufacturing Technology Laboratory of Air Force's Aeronautical Systems Division.

## Rocketdyne to Build Space Engine Facility

North American Aviation proposes to start construction in April on \$815,000 facility to be used by its Rocketdyne Division to develop liquid propellants and engines for space space.

The construction, subject to approval by the White House Council of Administration, would be on land North American owns near the cities of Brea and North Azusa, about six miles north of North America's newly completed advanced solid propellant research facility.

Facility will be built with company funds and target date for completion has been set for October.

## USAF Contracts

Air Force Office of Scientific Research recently awarded 11 grants and contracts valued at more than \$1 million to aerospace and industrial and non-profit research laboratories. Basic research grants included:

**Acoustic Institute of Technology**, ATSD-100-100 for research in 100-100 and 100-100.

**University of Southern California**, Los Angeles, ATSD-100-100 for research in 100-100 and 100-100.

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# DATA SYSTEMS DIVISION FOUNDATION FOR THOUGHT

## thinking data systems

RCA Data Systems Division, Van Nuys, California, is the foundation for much of the creative thinking taking place today in aerospace communications. In fulfilling its charter for the creation, development and production of ground based military data systems, data modern facility is making significant contributions in space age technology.

Scientists and engineers with experience and interest in expanding man's capability in military data systems are advised to inquire about the professional opportunities at RCA Data Systems Division, an equal opportunity employer. Just call or write:

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## Cape Airline Service

I wish to file note with an item published in the Feb. 1 issue of Aviation Week under the heading of Airline Officers (p. 47).

This article deals with the serious situation involved in Cape Canaveral, Fla. and real in pain. However inefficient sales, operations and information facilities are creating an increasing volume of complaints.

During Air Line recognizing the importance of ordering and service to the Cape Canaveral area in November, 1961, received the experience and information services formerly located at the Melbourne Airport in the Key Recreation Office located in Tampa. The change expressed service to the public in many ways. First of all it provided us to deliver the Office, Fla., telephone facilities, which long were privately located from Melbourne provided the public from a much wider area of the Cape installation in call Center Air Lines without making a toll call. Secondly, the new facility offered more telephone, trade and more people to assist them than did the former Melbourne Airport operation. Third, the change made it possible to receive information services related to the public 24 hours a day. It also made possible for the first time through available to all of Eastern flights, and the immediate confirmation of space requests on all of all Eastern flights with which the Tampa Area Office had direct communication. On May 5, 1962, the Tampa Area Recreation Office will become an electronic office serving the Western "Red Tint" System, thereby further expanding the service to customers.

In January, 1962, the Tampa office handled over 11,000 calls. In addition to the direct line from the Office from the Mail Room, Recreation Office located in January, 1962. To further point out that Center Air Lines is really not all concerned of the Cape Canaveral area, I mention that we also handle the operations and information services related to Orlando and Cocoa Beach, as well as Tampa Area Recreation Office.

Your reporter's remarks of course were not precise but I am confident that the do not point to Eastern Air Lines. To prove my point I suggest that if you reporter finds himself in the Cape Canaveral area he call AS 1515 for immediate information to the Airline in the World.

C. J. DeBore  
Anti Recreation Manager  
Eastern Air Lines  
Tampa, Fla.

## Training Slashed

Your "Cape Canaveral" issue, Anaheim, N.Y., touched upon one of the greatest mistakes within the industry, the decrease of the dissemination of flight engineer training programs in just 15 years (p. 126). The ALPA, through its rapid train-

ing efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

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In September of 1961 (a month before the ALPA's annual convention), the ALPA proposed a higher level of training for the flight engineers. This was not such a radical suggestion by ALPA which merely stated that the flight engineer was not required by the FAA because to the otherwise would require an increase in the number of flight engineers to be in the same way. The ALPA proposed a higher level of training for the flight engineers. This was not such a radical suggestion by ALPA which merely stated that the flight engineer was not required by the FAA because to the otherwise would require an increase in the number of flight engineers to be in the same way.

Following a recent visit to the ALPA, I am relieved to find that the ALPA is not such a radical suggestion by ALPA which merely stated that the flight engineer was not required by the FAA because to the otherwise would require an increase in the number of flight engineers to be in the same way. The ALPA proposed a higher level of training for the flight engineers. This was not such a radical suggestion by ALPA which merely stated that the flight engineer was not required by the FAA because to the otherwise would require an increase in the number of flight engineers to be in the same way.

How did this happen? Here are a few of the reasons. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

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The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

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Now that the industry training for flight engineers has been cut in half there is now a need to train the flight engineers to be in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

FAA's stated before presidential Executive Order Number 146 that "There has been an abundance of the job in professional staff of the flight engineer. The flight engineer's job will remain to be done but it will be assigned to other members of the crew. The flight engineer's job will remain to be done but it will be assigned to other members of the crew. The flight engineer's job will remain to be done but it will be assigned to other members of the crew."

This was his statement on every major airline and the ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

R. A. Haines  
President  
Resistoflex International, Inc.  
Washington, D. C.

## TFX Fighter Award

During February the TFX tested flight problem with some interest. I was applied to the ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

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ALPA's approach suggested this idea in order to increase the industry that the ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way. The ALPA, through its rapid training efforts, has been able to increase the number of its members in the same period in the same way.

## Information About Teflon Hose From The People Who Invented It

No. 1 is a zero

## SIGNIFICANCE OF COLOR

Resistoflex originated and in 1953 introduced Teflon\* hose assemblies via gas turbine applications. Since then millions of assemblies have gone into service in all areas of the aero-space industry, and an outstanding record for performance and reliability has been compiled.

You have undoubtedly observed Teflon hose tubing in many colors, with black being predominant. Black is the color of the hose developed and manufactured to this day by Resistoflex. In fact, ONLY Resistoflex and its licensees, here and abroad, manufacture black hose.

The black color is a result of a carbon black component being added to the Teflon extrusion compound by a process covered by Resistoflex Patent No. 2,752,637. The purpose of the carbon black is to act as a moderator for the large liquid extrusion-lubricant fraction of the Teflon resin mix. Its excellent absorption characteristics and fine particle size provide millions of microscopic lubricant reservoirs uniformly dispersed throughout the mix. Despite the most exacting controls, Teflon resin displays a wide

range of lubricant retention capability. Hence, the carbon black particles, in their function as a moderating agent, serve as suppliers of additional lubricant or reservoirs of excess lubricant during the passage of the resin mix through the vital constriction throat of the tubing extrusion dies. For this reason black tubing has consistently shown uniformity of structure.

Some have assumed carbon black was merely a color coding for identification. Some have even thought coloring was to hide defects. Some colorings used, because of their poor dispersal characteristics, have resulted in serious agglomeration problems and unsuitable structure. Uncolored hose, while not aggravated by the improper use of pigment, continues to be plagued by structural defects resulting from the variation in resin lubricant absorption capability.

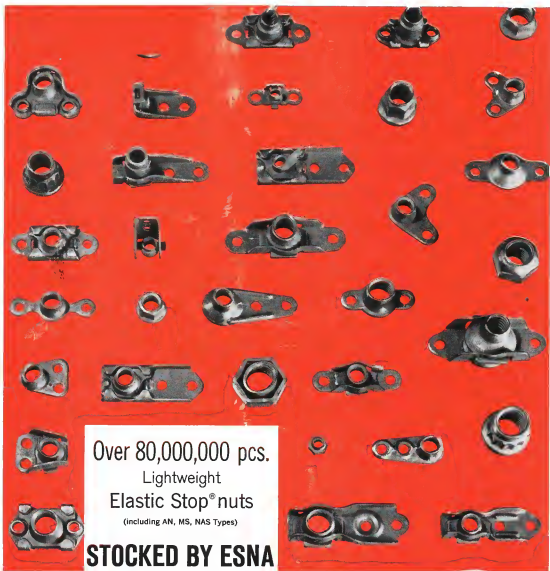
Some day the basic resin, which has improved in uniformity over the years, will not require a moderator. Until then, Resistoflex will continue to manufacture black hose by the same methods that have been so well proven in field service.

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